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The Investigation of Alternators. ON another page is given a very pretty method for getting the periodic curves of alternating currents which has been devised recently by Dr. Duncan. It possesses in a high degree the merits of simplicity and accuracy and avoids very neatly some of the usual experimental difficulties. The only apparent disadvantage is the multiplication of instruments, but Dr. Duncan's experience has shown that there is no serious difficulty here, for the rudimentary dynamometers used can be made very cheaply and rapidly. The details of the experimentation are not yet at hand, but from the nature of the apparatus it seems clear that they will not involve any particular difficulties, and that a very useful addition has been made to our present modes of measuring the periodic currents which play so important a part in applied electricity at the present day.

A Hard Question to Answer. WHAT are our rapid transit friends doing in these days, and when do they expect that the modified arcade railway scheme is likely to have a tangible existence? It is comparatively easy to draw up promising plans and specious specifications, but to render them sufficiently alluring to entice investors into giving up their good gold may prove a task much harder than had been anticipated. Seriously, the chances of an electrical rapid transit system in this great city of New York have not been greatly enhanced by the labor that has been spent on the subject up to date. Unless the metropolis is vastly more active than usual we shall have the privilege of seeing facilities in Chicago by the time the World's Fair opens that will quite put into the shade anything then existing here. The subject has been agitated for several years without producing as yet anything that gives real encouragement to the public; meanwhile the situation is getting steadily worse, and it is high time that something should be done. It might be well to borrow a little of the snap and enterprise of the Windy City to accelerate the slow course of wire-pulling and log-rolling that seems an essential part of any great enterprise in New York.

A Unique Electric Lighting Display. PERHAPS the most magnificent display of electric lighting to which New York has ever been treated may be seen at the great Madison Square Garden, itself a building alike beautiful architecturally and artistic in its decorations. Those who were fortunate enough to witness the illumination of the tower on the night of November 2 will long remember it. Elsewhere in our pages we present our readers with views of the most striking features of the illumination and a brief account of the means by which the work has been so successfuly done. The lighting of the immense interior has always been effective, but was doubly so during the past week while the chrysanthemum show was in progress, and one of our artist's sketches gives a striking view of the wonderfully fine effects obtained by the use of long festoons of electrically lighted Chinese lanterns and the brilliant illumination of the exhibits under the rays of the hooded lamps suspended everywhere in the Garden above them. But it was in the tower that the finest effects are obtained, for in addition to the beautifully grouped incandescent lamps two search lights were placed on the roof and on the tower, and at its topmost pinnacle the crescent in which stands the great statue of Diana, that serves as a weather vane, was brilliant with 200 lamps. On Monday evening, just after the statue was put in position, not only were all the electric fixtures aglow, but at 10 o'clock the entire tower shone fiercely bright with red fire burned all about it, and its top was half hidden in the coruscating shower of stars from fireworks discharged on the lower balconies. This, of course, was but a temporary scene, but the electric display is a permanent one, and the tower of the Garden is a brilliant feature of upper New York every evening. Altogether the electric light has been used here in a marvelously effective manner, one which may be copied elsewhere but can scarcely be excelled.

The Settlement of Patent Office Interferences. IT is reported that at the next session of Congress a bill will be passed to expedite the decision of interference cases occurring in the Patent Office. It has been obvious for some time that some such step should be taken, for the reason that the procedure of the Patent Office has given great opportunity for abuses, a chance which has been taken advantage of in a large number of cases. There are several such instances in the history of the various telephone applications during the past ten years. We have called attention to them already, with more or less effect. The remedy proposed is a somewhat singular one, being nothing less than turning over the interferences to the Circuit Court within 60 days after they are formally declared. An appeal, of course, can be taken to the Circuit Court of Appeals. Under such an arrangement the responsibility would be shifted from the Patent Office to the Circuit Court, and the final decision would be subject only to such delays as generally pertain to cases before that tribunal. The proposition is a specious one, but we very much fear that the result will not be altogether satisfactory. The suggested arrangement will relieve the Patent Office of interferences, but whether it will be able to go further and relieve the public from the improper delaying of patents is quite another matter. In the hands of attorneys anxious for delay, as they would be when delay was to be the purpose of both sides, a case can be made to drag its slow length along for a very considerable period, even now, and when the Circuit Court docket becomes crowded with interference cases facilities for killing time will multiply. It is a very difficult matter to hasten the settlement of such questions with entire justice to both parties; we incline to the belief that the proper way of securing this much to be desired end is by changes in the Patent Office practice rather than by referring the whole matter to the courts.

Foreign Exhibitors at Chicago. THE report of Mr. J. A. Hornsby, secretary of the Electrical Section of the Columbian Exposition, on the results of his mission abroad, is, on the whole, a most encouraging document. It shows the great interest taken abroad in the subject, and the hearty co-operation that is assured by a number of the most prominent foreign manufacturers. The degree of specialization in foreign electrical work is such as to make individual exhibits less complete and general than would be usual with American manufacturers, nevertheless the great European firms are not behindhand in any of the departments of electricity, and their presence at the Columbian Exposition will add much to its general interest. Especially encouraging is the apparent desire of our foreign friends to participate in the electrical service of the exposition, and to extensive engineering work if they are given the chance, long distance transmission of power, high speed railway service and similar propositions have already been made, and if these are met half way, as they should be, by the management of the exposition, there is little doubt of a most valuable and instructive series of foreign exhibits. With respect to the electrical congress, the suggestions made are good. The point in which the Frankfort congress failed was in general official recognition. It is not at all necessary for our own government to organize and run the congress, but it is well, however, that it should be the official source of international invitations and should be ready through its delegates to give a more formal and binding character to the deliberations than could otherwise be obtained. We in America scarcely appreciate the importance attached to red tape, great seals, and other evidences of official favor by foreigners. It is highly desirable that such a great electrical congress should be held in 1893, for the time is now ripe for a general discussion of a considerable number of practical questions, and for the giving of a universal character to electrical dimensions and nomenclature.

Electric Search Lights. THE paper by Mr. C. B. Boyle in the current issue should prove of no little interest to those of our readers who have to deal with difficult problems in electric lighting. Diffused illumination is not hard to accomplish, but when it becomes necessary to fulfill the conditions required of a search light, to throw an immensely powerful beam over a limited area for purposes either peaceful or warelike, some purely optical difficulties are met that have not as a rule been successfully avoided. Given, an electric arc; required, to gather the maximum possible amount of light from it and to project this in a single parallel beam; such is the problem. The most obvious solution is to take advantage of the properties of a parabolic mirror, which parallelizes all rays reflected from it and proceeding from its focus. In the ordinary Mangin projectors used for naval search lights a very powerful arc is placed in an elongated drum at the focus of the parabolic mirror at the back and sometimes a Fresnel lens system at the front. The interior of the drum is blackened and the light collected into a parallel beam is the sum of the reflected and refracted beams from the arc. Of the total light emitted of course a large proportion is lost in the drum, only that is utilized which is sent out within the spherical angles subtended by the reflector and lens system respectively. Sometimes the latter part of the apparatus is omitted, and in any case the spherical angles are not very large, so that of the total illumination only a comparatively small fraction is available. Even with this apparatus, however, magnificent results are obtained and a luminous and nearly parallel beam of immense power pierces the night for several miles out from the projector. In war the search light is to-day by no means an unimportant weapon of offense or defense. In its first function it serves to interfere with the maneuvering of the enemy by throwing a blinding glare into the pilot's eyes and rendering erroneous his judgment of distances and direction. As a defensive weapon its virtues are well known, searching out an approaching vessel and surrounding it with a glare of light that renders it a ready target for the rapid fire guns with which every modern man-of-war is equipped. The former use was well illustrated a month or two since in the sinking of a French torpedo boat by another vessel of the same squadron, owing to the tremendous blaze of light rendering the pilot quite unable to tell where he was going. An extremely pretty specimen of defensive employment was given during the recent war in Chili in and about the harbor of Iquique, where on different occasions a search light on shore and still others aboard the men-of-war demoralized the attacking forces. The purpose of Mr. Boyle's paper is to point out the means by which the effective beam from a given arc can be employed more efficiently than at present. The parabolic mirror is retained but is of such shape as to subtend a far greater spherical angle than usual; in addition, the light sent directly forward from the arc without reflection, and which under ordinary circumstances is diffused through the spherical angle not subtended by the reflector, or stopped by a concave mirror that turns a portion of it into the effective beam, is gathered by a lens or a lens and small reflecting system placed well inside the main mirror and near enough to the arc to pick up all the stray light. The diagrams show very plainly the effect. Nearly the whole of the light emitted by the arc can be thrown into parallelism and utilized, thus obtaining a beam equally as powerful as that of the present search lights with a much smaller initial illumination, and avoiding to a very great extent any lateral scattering of the light. The only apparent difficulty is the size of the mirror required and the proximity of the reflecting surfaces to the arc, and, consequently, the danger of troublesome heating. The first is not serious, as a little consideration will show that the mirror need not be of inordinate dimensions, although much altered in shape. The second might very well be avoided by making the reflecting surface of silvered or nickeled copper, and encasing it externally in the vicinity of the arc with a water jacket, not at all an impracticable proceeding either on shipboard or on land. Various other ingenious devices are detailed in the paper in question, but they all depend upon this same general principle of the more complete utilization of the light by means of a secondary reflecting or refracting system.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

London, Nov. 9, 1891.—I can announce this week but few new electrical enterprises; perhaps the most important is proposed on the part of the Brecon municipality to run an electric line up the neighboring heights known as the Beacons. It has been a very difficult matter for electric traction to get a footing in this country, but this has apparently now been done, and we may expect a considerable increase in the number of electric roads.

On the continent the most recent suggestion comes from Berlin, where it is intended to organize an electric launch service on the river Spree just outside the city. There are a considerable number of popular resorts upon the river that can be very conveniently reached by the line of launches contemplated.

Prof. H. von Helmholtz celebrated his seventieth birthday last week with some ceremony, in which a number of his distinguished friends participated.

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NEW BOOKS.

A Practical Guide to the Testing of Insulated Wires and Cables. By Herbert Laws Webb. Pp. 118. 38 Ills. D. Van Nostrand & Co. New York, 1891. Price, $1.00.

This little volume is a valuable addition to the list of special books on electrical testing, and particularly so in that it takes up a department not very fully treated elsewhere in electrical literature. Mr. Webb has had a large amount of practical experience and his directions are those which have testified to their own value in everyday work as well as in the laboratory. The volume is a small one, but quite complete in its way, and as might be expected from its authorship written in a plain and interesting style. It should prove very useful to those who are engaged in telephony, telegraphy and underground or submarine electrical work in general.

Electricity for Engineers. By Charles Desmond. Revised Edition. Pp. 425. 131 ills. Chicago: Engineer Gazette Company. 1891. Price, $2.50.

This volume is an enlarged and revised edition of the admirable little book by the same author reviewed in these columns some months since. It has been considerably enlarged, and in fact a distinct second part has been added dealing with alternating current machinery. To the original portion of the book has been added a brief chapter on motors, treating the subject less in detail than was the case in the first part of the work, but still giving a clear idea of the characteristics of motors in general. The second part of the book deals exclusively with alternating current apparatus and takes up not only dynamos and transformers but the alternating current arc lamp, and a large variety of forms of measuring apparatus. The last two chapters of this portion on Ohm's law and on ground alarms and leak detectors might better have been transferred to the first part of the book. It is a pity that more working directions for the operation of alternating current apparatus were not given, for the subject is one very little treated in the literature of electric lighting, and a discussion as full as that accorded to arc machines would have been an advantage. On the whole the second edition of the book is satisfactory but too brief, and the entire volume is one that can be cordially recommended to those who desire a plain, straightforward account of electric lighting systems.

Preliminary Note on a Method for Determining the Periodic Curves of Alternating Currents.

BY DR. LOUIS DUNCAN.

The experimental methods heretofore used for the determination of current and electromotive force curves in alternating circuits present many difficulties and are cumbersome and tiresome. Most of those now in use are based on the experiments of Joubert, who obtained the E. M. F. curve of a De Meritens dynamo by making instantaneous contacts between the dynamo circuit and measuring circuit at different points on the E. M. F. curve. This method was modified by Messrs. Wilkes, Hutchinson and myself* to give curves of primary and secondary E. M. F. and current in alternating circuits containing transformers, condensers, etc. Our method has been copied by Prof. Ryan and others, and the results which we obtained some years ago have been duplicated and extended. M. Blondlot has recently still further modified the method by using a galvanometer, through which a condenser charged to a potential representing different points on E. M. F. curves is discharged, the deflections being photographed. By using two contact making arrangements or wipers, with two galvanometers, two curves were obtained at the same time.

The difficulties of most of these methods lie in the very considerable potentials used on the commutators—as much as 1,500 volts in some experiments—the fact that only one curve can be obtained from each commutator, with the possibility of error due to the contacts.

The following method is simpler and gives better results: To get the four curves representing the primary and secondary E. M. Fs. and currents, four small dynamometers are made and their stationary coils wound for primary current, primary E. M. F., secondary current and secondary E. M. F. respectively, their movable coils being connected in series, in circuit with a few storage or other cells, this latter circuit having one end connected with the contact point on the dynamo shaft, the other end connected to a wiper touching the contact point at each revolution. The wiper is movable through the arc of a circle (180° is sufficient unless the curves are to be photographed). These dynamometers may be cheaply and quickly made with wooden spools and a quartz fibre suspension, the current being carried by pieces of coiled tinsel or fine wire as in a D'Arsonval galvanometer. Four of them may be easily made in a day.

In making the experiments the deflections of the dynamometers are either observed or photographed. It is evident that if the instantaneous current in a movable coil occurs when the current in the stationary coil is zero there will be no deflection; if the latter current is at its maximum, the deflection will be a maximum; while for intermediate values the deflection (I am considering small deflections, of course) will be proportional to the instantaneous value of the current in the stationary coil. By moving the wiper through 180 degrees uniformly if we are photographing we get all of our curves simultaneously with no possibility of changed conditions changing their relative values. A galvanometer in circuit with the movable coils allows an absolute scale to be applied to the curves, after the dynamometers have been once calibrated, and eliminates any error caused by the wiper. We are thus able to obtain any number of curves simultaneously with only one commutator, with only a few volts on this commutator and with no possibility of errors due to the wiper speed.

Pure Platinum and Its Alloys.

Platinum can now be prepared by a new process, says the *Electrical Review*, of London, in a state of such purity that it does not contain more than 0.01 per cent of other metals. When the metal possesses this degree of purity it is too soft for many purposes, but it can readily be alloyed with iridium when in this state, and the result is a product of very great durability; the most suitable proportions are platinum 98—99 per cent., iridium 2—1 per cent. The pure iridium used in making these alloys by W. C. Heraus had a specific gravity of 22.35 and was extremely hard, being equal in this respect to blue-tempered steel. It was completely indifferent toward nearly all chemical reagents, and only fusible in small quantities in the strongest heat of the oxyhydrogen flame. Heraus has also prepared alloys of pure platinum and rhodium.

* The Electrical World, March, 31, 1888. It is a mistake to think any special electrometer is needed for this method; an ordinary Thomson quadrant electrometer was used in our work and our measurements were apparently made as easily as those of later experimenters.

Aluminium vs. Copper.

BY A. SAUNDERS MORRIS.

Electrical conductors may be divided into two general classes, those used in the strictest sense of the word for conveying the current from point to point, and those used on generators, motors, transformers and the like, forming an integral part of the apparatus for the transformation of energy.

Whether aluminium will be used for the former class depends largely on its price, while its use in generators, etc., depends not only on its price, but also upon the design of the apparatus and the cost of the other materials which go to form the complete machine.

Glancing for a moment at the physical properties of aluminium and copper, we see that aluminium is about one-third the weight of copper, the specific gravity being 2.67 and that of copper 8.89. The specific resistance is, however, almost twice as great as copper, the proportion being as 1 : 1.845. The weight for an equivalent resistance will therefore be .555 that of copper, or cost of aluminium $= \frac{\text{cost of copper.}}{.555}$

This is of course equivalent to saying that if the cost of copper wire is 15 cents, aluminium wire must be sold for 27 cents to compete with it for electric conductors. As the cross-section of an aluminium conductor to have the same resistance as one of copper must be 1.845 times as great, these figures are only correct where uninsulated wires are used.

Since the areas are to each other as 1 : 1.845 the circumferences will be to each other about as 1 : 1.36. Hence the insulation for an aluminium wire should weigh about 36 per cent. more than for a copper wire of the same resistance. The practice of manufacturers of insulated wire is, however, to increase the thickness of insulation with the increase in diameter of the wire, which, of course, increases the weight of insulation at a greater ratio than 1 : 1.36.

The average saving in weight by using aluminium in place of copper for insulated wire, as estimated from the tables of a well known manufacturing company, is 33 per cent. for the lowest grade of insulation, 22 per cent. for the next grade and 18 per cent. for the best. Another make shows a saving of 26 per cent. and still another of 24 per cent. These figures are for sizes of wire varying from that equivalent in resistance to a No. 0 B. & S. copper wire, to No. 9 inclusive, and the saving in general increases with the size of the wire.

If aluminium were used instead of copper in lead covered cables, the weight instead of being decreased is increased, and in the example taken, which was a No. 2 B. & S. copper conductor with one-eighth insulation and a lead cover three thirty-seconds thick, the increase in weight by using aluminium was something over 43 per cent. As most lead covered cables for electric light and power work are for use underground, the question of cross section is of far greater importance than weight, and hence there is nothing better than copper.

The disadvantages in the use of aluminium for electric conductors are: First, increased cross section and its attendant circumstances, increased surface to be covered with insulation, increased surface exposed to wind and increased danger from accumulations of snow and sleet, as well as the objectionable appearance of larger wires than at present used. Second, the great difficulty of soldering, although this objection is largely decreased by the use of mechanical joints not requiring solder. Third, the decreased tensile strength, which, however, is partly neutralized by the fact that the cross section is nearly doubled.

Its sole advantage is the decrease in weight, but the strength of poles is ample to support the weight of copper wire were it not for the side strains to which they are subjected, and which, in general, would be greater for aluminium than for copper.

We now come to the consideration of aluminium in the construction of converters, generator, motors, etc. Taking a well known make of converters in which the iron core surrounds the copper wire, as an example, and replacing the copper with aluminium having the same resistance and number of turns, the insulation being the same, we see that the area of the openings in the iron core must be increased about 31 per cent., and preserving the same cross section of iron magnetized its weight has been increased 11 per cent. But the weight of conductor is about half as great for aluminium as for copper, and this decrease just about balances the increased weight of iron. The actual saving in weight is about two per cent., but the volume is increased, say, 11 per cent., and consequently the weight of the containing case would have to be increased, which would really make the converter wound with aluminium somewhat heavier than one wound with copper and its efficiency would probably be a trifle lower, although its ohmic resistance is the same.

If aluminium were used instead of copper in a direct current generator, the armature, to have the same ohmic resistance and the same air gap, would have to be considerably larger. This would in turn require larger fields and these would have to be somewhat increased in general dimensions to accommodate the increased section of wire, so that in all probability what would be saved in weight by using aluminium would be lost on account of the greater weight of iron necessary for structural reasons. Indeed it would be difficult to use aluminium without changing the design materially and probably sacrificing efficiency. The

inability to use solder becomes a far more serious difficulty in machine construction than in line work.

From the facts it would seem that, however great the usefulness of aluminium in general, its substitution for copper in the field of electricity is limited, even if its present price were materially reduced.

A Temple of Electricity.

BY M. J. SULLIVAN.

A gigantic pile of marble, brick and terra cotta, rising 80 feet in the air, and covering an entire city block; a flood of light stealing through numberless openings in massive walls; a perfect fringe of turrets capping the main structure, each surmounted by a cluster of electric lamps that fling their rays high into the night air, and looking for all the world like groups of stars that had been caught in their downward course; a pillar of fire rising 350 feet from its foundation, broken here and there by pagodas fairly afire with glow and arc lamps, and capped by the gilded figure of the goddess Diana—this is the picture presented to the eye as one gazes at night upon the new Madison Square Garden in New York City.

Without overlooking all the triumphs of the electric light, and not ignoring the excellent engineering and electrical work that has already been done, it is safe to say that this "Temple of Electricity" stands unrivalled for the variety, utility, decorative effect and artistic arrangement of its electric light. As a demonstration of the perfection, flexibility and safety of the electric light for illumination, in both the decorative and useful branches, this installation is certainly a model; and the advocates of the dynamo and lamp could well rest their case upon this single exhibit to prove everything they have ever claimed.

From the cellar to the apex of the tower, nothing is used but the electric light; and when it is considered that beneath this broad roof is an amphitheatre capable of holding 2 ,000 people; a large theatre; a magnificent concert hall, besides roof garden, dining saloon, lobbies and a large arcade over the entrances, depending solely upon the wires for light, the rather broad claim that this is the most splendid isolated plant in existence seems justified.

An arcade supported by marble columns extends along the entire Madison avenue front and about one-third the distance on both Twenty-sixth and Twenty-seventh streets. This novel feature forms a perfect awning over the side walk. It is lighted by a series of incandescent lamps varying from one to three on each arch. The arrangement of the lamps is such as to make numerous figures of diamonds, the intersecting point of two figures marked by a 100-c. p. lamp.

At the apex of each arch are two 16-c. p. lamps, one reflecting from the keystone inward and the other outward to the street. This construction brilliantly lights the sidewalk, and even the casual passer-by feels a warmth and cheerfulness to be found nowhere else in New York streets.

Ascending by the elevator we reach the roof garden. This garden occupies the roof space above the concert hall and theatre fronting on Madison avenue. Extending around three sides of this inclosure is a covered promenade from which rise, at frequent intervals, a series of turrets brilliantly lighted. An idea of the beauty of this feature of the Garden may be gained from the sketch by our artist, which shows the Madison avenue wall.

ELECTRIC LIGHTING DISPLAY ON THE TOWER OF THE MADISON SQUARE GARDEN.

It will be noticed that alternated with the columns are incandescent lamps which form a garland of light. Surmounting the whole is a group of 12 incandescent lamps inclosed in weather-proof globes. At night these clusters can be seen a distance of 10 miles, making the roof a sheet of fire. Between each two columns of the row forming the outer wall of the promenade is a 100-c. p. lamp, which greatly adds to the general lighting effect. Making the cluster of lights on the turrets a permanent affair is an entirely original idea. It serves not only as an advertisement, but also as illuminating the roof garden.

Here, as elsewhere about this immense temple of amusement, the electric light is part and parcel of the entertainment. Whatever else is furnished to amuse or interest, the exquisite lighting effects are ever in sight, so that no one can feel uncomfortable or bored. In this one regard alone the electric light has fulfilled the boasts of its early champions of being "the only illuminant adapted to the needs of modern civilization."

This roof garden is supplied with current by a separate feeder from the east end of the amphitheatre cellar, the light used being an equivalent of 1,500 16-c. p. lamps.

The giant tower rises 200 feet into the air before any of the decorations begin. Its four massive walls are speckled with little windows, from which stream the light of the glow lamps that illuminate the interior. At each of the four corners, where the square construction of the tower ends, is a group of lights. From this point upward the tower is a perfect pillar of fire, being formed of a series of pagodas brilliantly lighted from both outside and interior, the light at every point accentuating the architectural work.

We ascend by a circular staircase to the upper landing, from which a magnificent view of New York City can be obtained. Higher yet we go through a perfect maze of loggias, columns and electric lights until we reach the search-light landing. Above this again is what may be called the beacon of the tower. It is a dome-like lattice work of iron, inside of which are four 200-c. p. arc lamps burning on the regular incandescent circuit.

We are now 341 feet from terra firma, and standing amid lights burning at the highest point ever attempted, with the single exception of the Eiffel Tower. As we look down upon the building we see 200 c. p. lamps burning in mid-air, and used wholly for decorative effect. Above us is a large crescent containing about 200 incandescent lamps, and forming the foot rest, as it were, of the figure of Diana above. Above this crescent of fire is a spray of eight 50-c. p. lamps, invisible from below, but massed by reflectors which throw their light on the gilded figure above. The Goddess is, in this instance, used as a weather vane, and by the aid of the electric light the direction of the wind can be learned even in the darkest night.

Mention has already been made of the reflector, but it possesses a novelty and perfection worthy of more than passing notice. The projector proper was specially designed by the Edison General Electric Light Company to exceed in candle power that of any lamp ever placed for permanent construction. It has a total illuminating power of 10,000 candles, using carbons one inch and a quarter in diameter. The reflector is mounted on a car operated by a bicycle arrangement for moving it around the tower on a circular track. Current is taken from a trolley wire, and the lamp is so geared that it is adjustable for all altitudes. It will throw a bar of light three feet in diameter for more than three miles, and enables the visitor to see all points of New York City at night.

Starting from the main entrance on Madison avenue we find the corridor artistically lighted by groups of incandescent lamps, there being a perfect line of light on either side that forms an avenue from the street to the amphitheatre. This is the greatest part of the entire establishment. It has a total length of 650 feet, and a span from column to column on the sides of 170. In this handsomely decorated auditorium it is possible to accommodate 23,000 people.

The special feature of the permanent lighting of this inclosure is the lines of light on the girders of the roof. The crude iron of the structure is utilized as an immense fixture holding 1,400 16-c. p. lamps, forming a star-lit firmament of exquisite beauty. It is estimated that it would require four times the number of five-foot gas burners to get an equal amount of light. In this ceiling light there is no cluster, no fixture. On each column around the oval is a shield of 12 incandescent lamps. These make an admirable offset for the sheet of light overhead.

We give herewith an illustration of the temporary lighting arrangement fixed for the flower show. This is one of the most interesting lighting effects ever attempted.

Strung on temporary wires in mid-air are 1,500 16-c. p. lamps, interspersed here and there with a "Ward" constant current arc lamp that seems to be on most friendly terms with its smaller yet more powerful rivals. Each incandescent as well as arc lamp is hung in a Japanese lantern, making a perfect canopy of lights of the most varied colors imaginable. The spectacle of arc lamps with delicate paper decorations is certainly a novel one. From their burning it is impossible to distinguish the arc from the incandescent, the only noticeable difference being that the latter is larger and shows a bluish tint.

In the centre of the garden is arranged a flower booth, the draperies of which are alive with incandescent lamps. From a 100-c. p. lamp encased in a large glass globe festoons of silk fall away in all directions like a shower of gold. Hanging above the whole is a circular shield of lamps that throw their rays through silken shrouds.

The effect of the arc and incandescent amps blending together is very pleasing. The attempt here demonstrates that there is a great field for constant current arc lamps when used for decorative lighting effects. Taken as a whole the lighting arrangement gives one the idea of an immense Japanese festival. The harmonizing of such a mass of colored light with the exquisite tints of ten thousand chrysanthemums makes a picture that must be seen to be appreciated; it cannot be described.

The lighting effects of the concert hall are, without any question, the most superbly beautiful of anything everattempted in the way of illumination. They may be described as a striking illustration of decorative lighting without being decorative in itself. The remark is attributed to agreat electrician that "no fixture could ever be so beautiful as a flexible pendant." Be this artistically true or not, it is certain that the ceiling of the hall we are describing would not admit of anything in the way of a metal fixture, unless at the expense of detracting from the architectural finish.

The ceiling is a series of deep set and handsomely designed panels. From the centre of each hangs a 100-candle lamp, suspended by a flexible cord about 25 inches in length. A continuous garland of flowers in bas-relief extends around the side walls close to the ceiling. Placed in a delightfully negligent way throughout the entire garland are hundreds of incandescent lamps. The background being perfectly white, nothing can be seen of the lamps but the hair-like filament, which at this height becomes simply a mass of white light.

At several points on the side walls are graceful clusters of three lamps so arranged that one could hardly tell whether they were decorations or lights. More than 500 lights are used in this large room, yet not an inch of metal fixture mars the symmetry of white and gold so admirably obtained.

In harmony with the other features of the Madison Square Garden, the theatre has most perfect electric lighting arrangements. The stage is equipped with three rows of light—white, red and blue—for both foot lights and each of the borders. This allows of effects for all possible conditions of stage setting.

The regulating apparatus for the theatre lights is of special design, and so arranged that not only the lights in the auditorium, but also on the stage, can be controlled and operated with perfect ease by one man located at the right of the stage.

The dynamo room is located under the sidewalk of the Fourth avenue side. Current is supplied from four No,

20 Edison dynamos, driven by two New York Safety engines. The wiring is on the well known Edison three-wire plan, the feeders running from the regulating board in the dynamo room to various points throughout the building. From these points the mains supply the current to the lamps.

The dynamo galvanometers and other indicating instruments are mounted on a marble board. Here the two pair of machines can be thrown in multiple. When desired current can be taken from the street service of the Edison Illuminating Company of New York, the instruments here indicating the pressure, and enabling the dynamo man to bring his current up to the right standard in case it is necessary to operate with both local and station currents.

Two sets of feeders of 750,000 c. m. run to the centre of the eastern basement wall. From here 25 mains radiate to all parts of the interior, each set being controlled by separate switches. Another set of feeders extend to the west end of the basement, and from a switchboard supply all the lights for the exterior. At the point of departure of these two sets of feed wires are three 1,200-ampère switches, used to throw in the street service. This immense flow of current is measured through an Edison chemical meter, and is perhaps the largest number of ampères yet measured through a meter. In all there are 6,000 incandescent lamps and 30 constant current arc lamps, making the whole installation a low tension system.

The entire electrical arrangements of this altogether remarkable plant have been under the direction of Mr. W. B. Hadley, representing the Edison company. His long experience and excellent judgment have enabled him to secure the happy result we have attempted to describe, and the work is a credit to him.

But while Mr. Hadley has had charge of and directed the general arrangements too much praise cannot be given Mr. D. C. Gilbert, Chief Electrician of the Madison Square Garden Company. He has had immediate charge of everything, and installed the temporary lighting for the flower show which we have mentioned. Mr. Gilbert has long been connected with electrical work. He started with the United States Electric Company seven years ago, remaining with that company three years. In this capacity he equipped such structures as the Evening Post, Equitable Life and Post Office buildings. He left this company to go with the Edison company, and has been with the latter until the present time, working from one position to another until he was given charge of this important plant. His work has been thorough and very clever, as all will admit who visit this veritable Temple of Electricity.

Electrical Central Station of the City of Trent.*

BY FRANK C. PERKINS.

This plant began operating June 1, 1890. The water power utilized is from the creek "Fersina," and 700 litres of water may be used per second with a useful height of 86 metres, giving 600 effective horse power. The channel is 850 metres long and is carried throughout in a tunnel. There are two cleaning and water reservoirs and two force conduits of cast iron pipes 650 millimetres in diameter and 860 metres long, making the total distance between the point of water supply and the electrical plant at Ponte Comicchio 1,750 metres.

At the generating station there are six Girard turbines, with horizontal shafts, each giving 140 effective horse power at 250 revolutions per minute. The turbines are provided with automatic regulators, and each turbine is directly coupled to a Siemens & Halske continuous current dynamo. These dynamos generate 160 ampères each at 500 volts maximum potential. The necessary measuring instruments, safety apparatus, etc., are supplied, as well as reserve pieces to be used in case of a break down. The station also has a repair shop with an 8-h. p. turbine, a traveling crane with a carrying capacity of 3,000 kilograms and all necessary tools for making repairs. The station is also supplied with telephone connections to the high level service reservoir and to the electric compensating plant in the town house.

In the town house, beneath the office of the manager, are two double dynamos called compensating engines, performing the compensation of unequal charge in the four groups of the distributing net. There is also a battery of accumulators, likewise serving for compensation, being reserved for the hours of maximum consumption, and furnishing current during the Sundays and holidays, when the dynamos are not working. There are also in this building the necessary measuring instruments and safety apparatus, telephone connections and store houses.

The tension in the net is 440 volts; the potential of the incandescent lamps is 110 volts, of the arc lamps 55 volts, of the electric motors 110 to 440 volts, according to their power. In the central part of the town lead cables are used of the system of Siemens & Halske, with double band iron armor; in the suburbs other conduits are used and in the houses lead cables laid in gypsum.

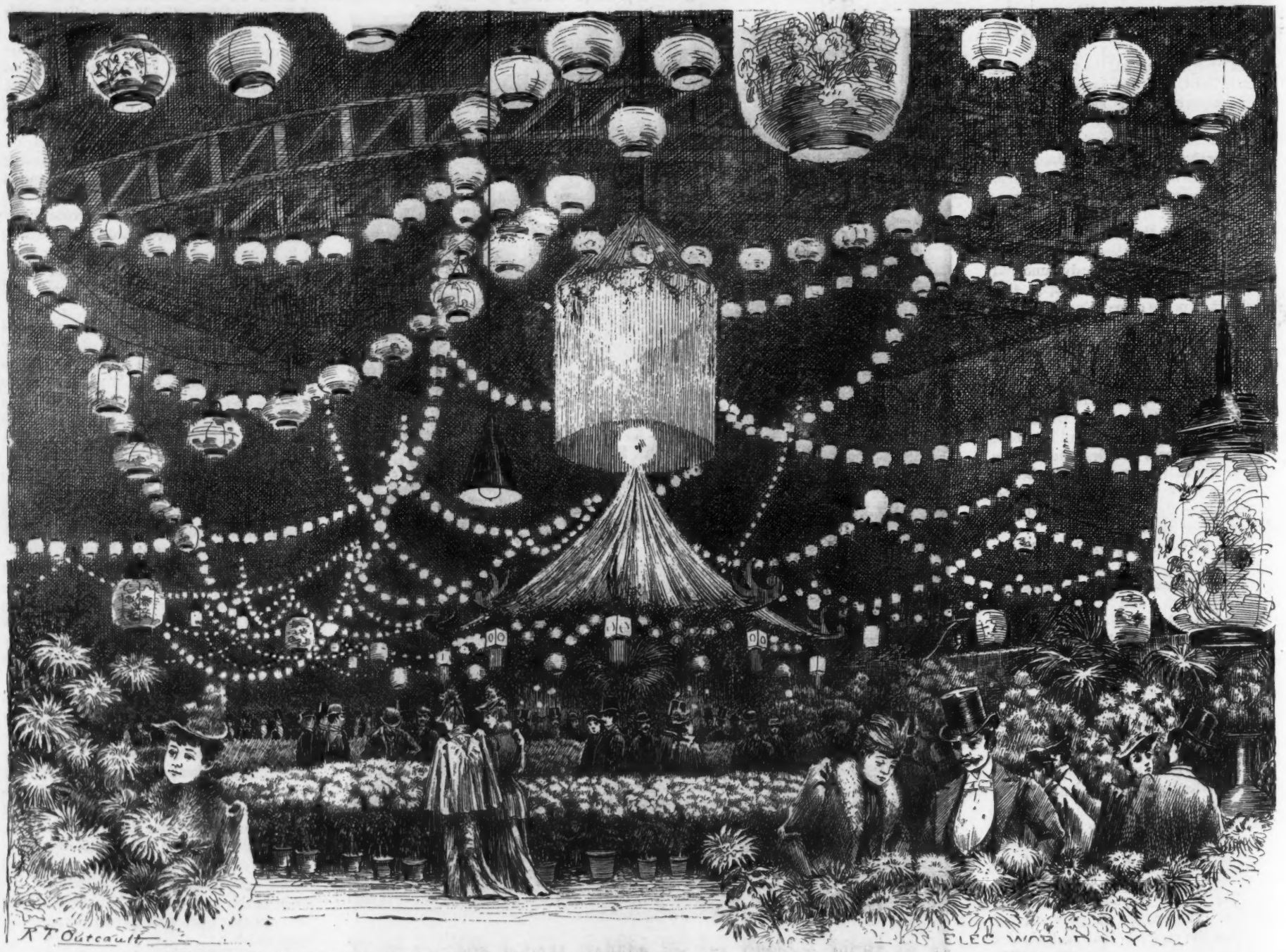
The management and administration are in the hands of the Municipality. The light and power are let to the consumers entirely by contract. There are no meters used, and every one uses the current to any extent he wishes for light during the 24 hours, and for motive power 20 hours, except Sundays and holidays. The rates charged are as follows: 1. For public lighting the city pays per year 10,000 florins for the electrical department, the same amount as was formerly paid for the gas and petroleum lighting.

2. For private lighting the consumers pay 50 kreuzers per year for every normal candle power for incandescent lamps of 5 to 35 normal candles and seven florins per year for every ampère of arc lamps.

3. For electric motors the consumer pays 20 florins per year for every horse power, measured at the turbines, or about 33 florins a year for every effective horse power of the electric motor.

4. For installation the consumers pay for all repairs, incandescent lamp renewals, and arc light carbons and lamps used. The consumers must buy their lamps, etc., from the Municipality. Incandescent lamps of 5 to 35 normal candle power are sold to consumers at two florins each, to workmen at one florin each. Electric motors can be ordered of any firm by the consumers provided they correspond to the prescribed terms.

* From a report by the city authorities for the Frankfort Exposition.



SPECIAL ILLUMINATION OF MADISON SQUARE GARDEN ON THE OPENING NIGHT OF THE FLOWER SHOW.

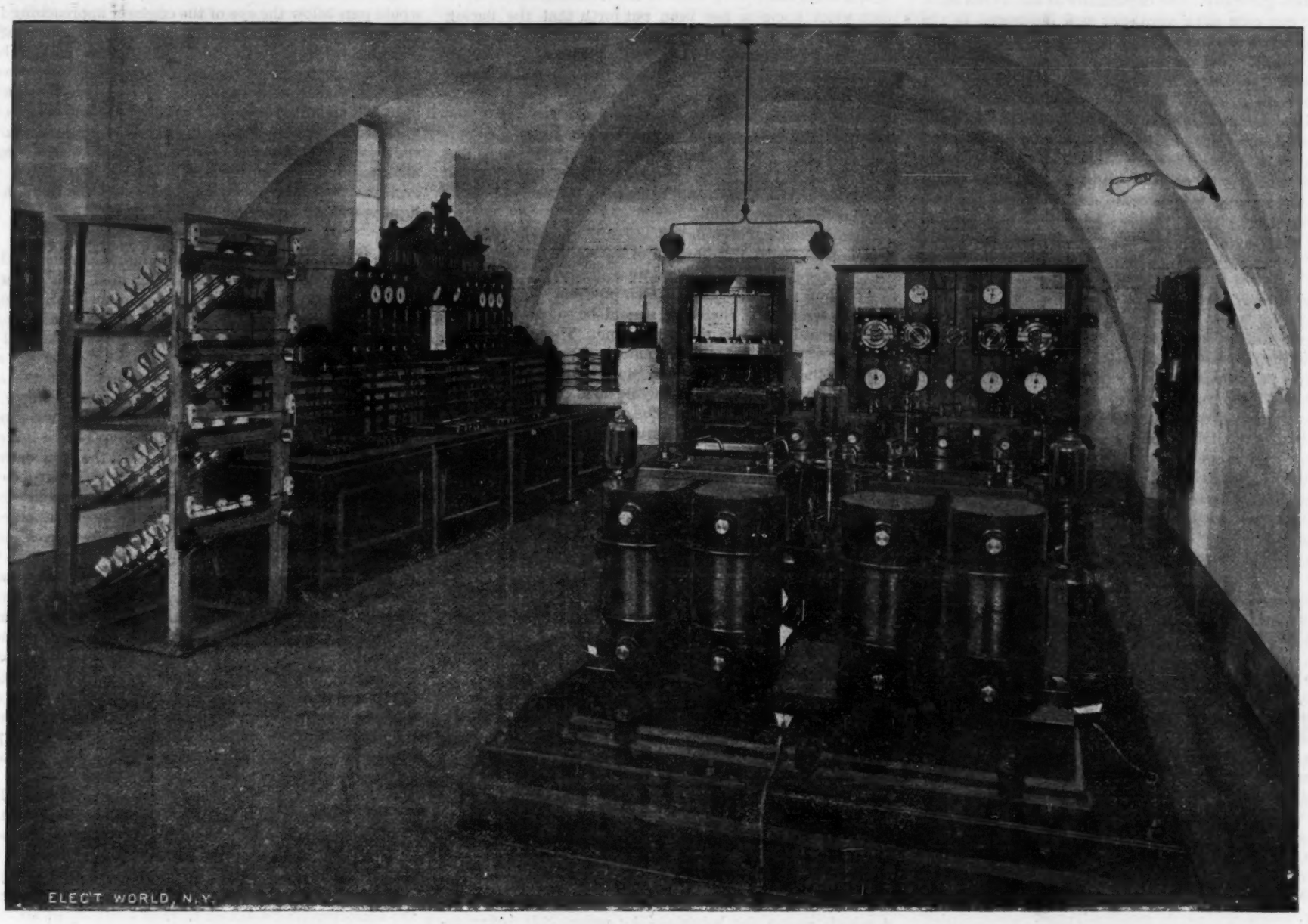
FINANCIAL RESULTS FOR 1891.

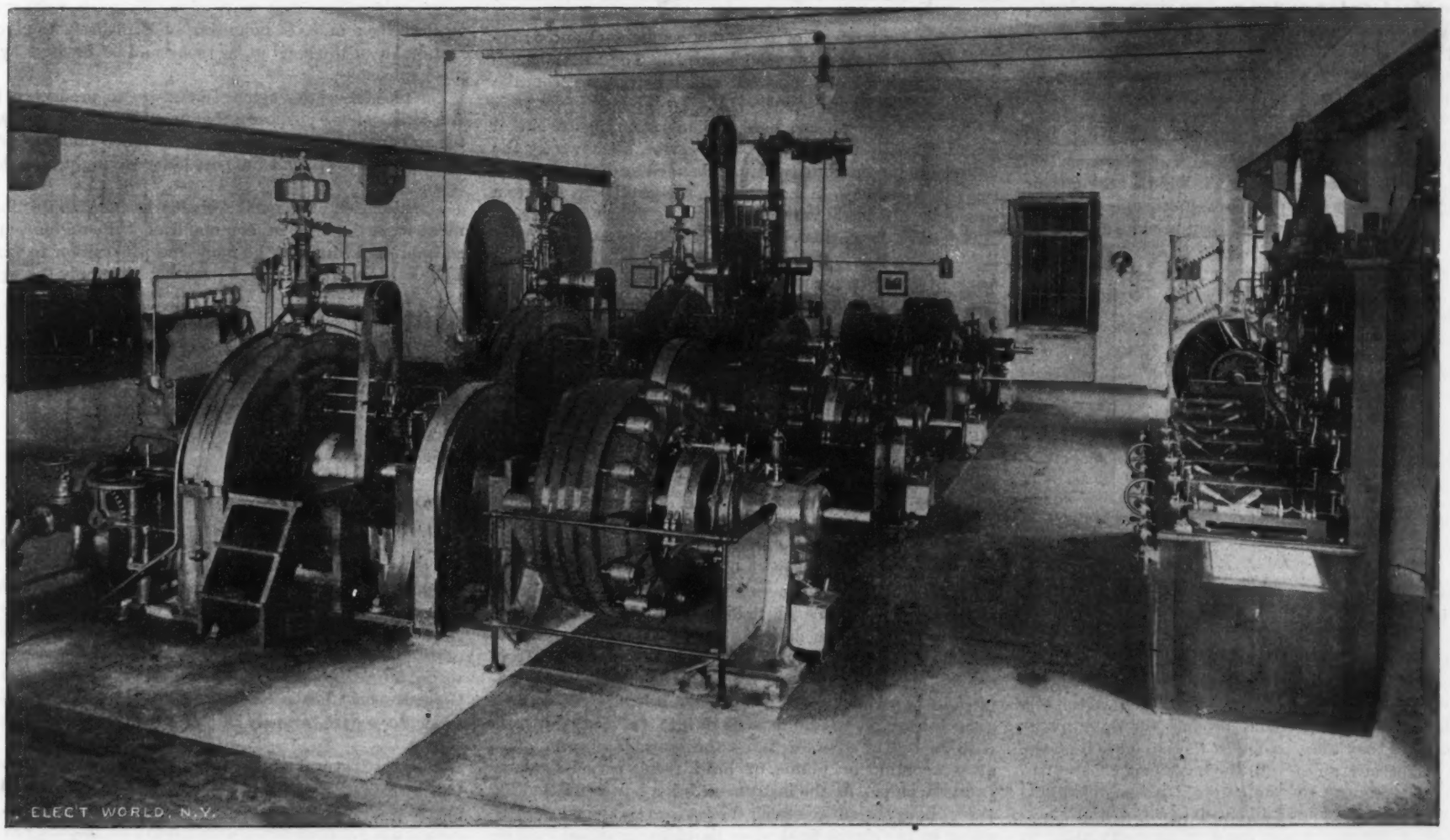
Receipts.			Florins.
From the Community	= cash for public lighting	=	10,000
" " Consumers	= 70,000 normal candles at 50 kreuzer.	=	35,000
" " "	= 30 arc lamps, about	=	1,500
" " "	= 200 h. p. at 20fl	=	4,000
	= profit of lamps, fuel, etc., about	=	6,000
	= profit of installations about	=	2,000
Total receipts			58,500
Expenses.			
Interest of plant @ 4½%			29,000
Technical management and workmen			5,400
Services of administration			3,000
Expenses of maintenance and miscellaneous			11,000
Total expenses			48,500
Remaining net profit			10,000

For the public lighting 22 arc lamps of nine ampères each are used, burning until midnight; 560 incandescent lamps are used all night. For private lighting there are 30 arc lamps of six ampères each and 6,000 incandescent lamps of five to 35 normal candles, mean illuminating power 12 normal candles; and 30 electric motors, varying in size from $\frac{1}{18}$ to 50 effective horse power, with a total consumption of 200 h. p., measured at the turbines. The town has 22,000 inhabitants, inclusive of 1,900 soldiers. The public electric lighting of incandescent lamps is alone three times as extensive as the former public gas and petroleum lighting of 230 lamps together, costing the community 10,000 florins. The gas works were opened in the year 1859, and had in 1890 a maximum consumption of 190 public lights and 1,900

private lights. At present the gas works have only 100 private lights and about 20 fireplaces, with a consumption of about 80 cubic metres of gas per day. The total cost of the plant was 650,000 florins.

There are several new installations to be made and many under negotiation, so that it may be expected that the private consumption will rise within a short time to 100,000 normal candles of incandescent lamps, and 300 h. p. for electric motors. The plant has a maximum capacity for 130,000 normal candles and 500 horse power, because the battery of accumulators can be charged from 11 o'clock in the night to 5 o'clock in the morning.





TWO INTERIOR VIEWS OF THE CENTRAL STATION OF THE CITY OF TRENT.

The city claims the plant is a complete success from the following points of view:

(*a*) From a technical point of view, because each effective horse power at the turbines delivers current for 150 normal candles of light from incandescent lamps; also from electric motors at the greatest distance from the station, 60 per cent. efficiency is obtained from water used at the turbines.

(*b*) From an administrative point of view, because each effective horse power at the turbines yields at least 200 normal candles from the incandescent lamps in use, and one effective horse power at the electric motors, if it is remembered that even during the hours of maximum consumption not all the lamps are burning, and that customarily the electric motors must be out of circuit during this time.

(*c*) From a social and economical point of view, because the tariffs are very low, and thereby the common retail trade is advanced.

(*d*) From a hygienic point of view, because the electric lighting is very speedily spreading into public establishments and private dwellings, and has thereby removed the unwholesome gas and petroleum lighting.

(*e*) From a humanitarian point of view, because the electric lighting is already introduced in almost 300 dwellings for workmen.

(*f*) From a financial point of view, because with the terms of consumption applied by the Municipality of Trent, the public lighting is cheaper than formerly, when gas and petroleum lighting was used, and the amount of light obtained is three times as great.

Optical Science in Its Relation to Electric Lighting.

BY CHARLES B. BOYLE.

As search lights for the merchant marine are now becoming an important feature of electric lighting let us consider what might be accomplished in that direction, as well as what has already been achieved in the construction of search lights generally. The capabilities of the search light in use by our own navy were very well illustrated in the display made in the harbor of New York on the occasion of the parading of our naval reserves. An interview with a young naval officer, who has had much to do with the construction of these instruments, showed that of all the light emitted from the arc, only that embraced by an angle of about 80 degrees was utilized. Careful investigation will show that this is only about one-tenth of the whole, the other nine-tenths being eclipsed, or prevented from escaping into the surrounding space, by being housed in by a barrel-shaped contrivance, inside of which the instrument proper is placed, and out of which none of the light emitted from the arc is permitted to escape, except the one-tenth, which is reflected from the silvered mirror and condensed by it into a nearly parallel beam.

Diagram No. 1 may serve to illustrate the working of this instrument, the point of the meeting of the two carbons being that from which the light is radiated. The concave mirror *M* is the reflector which subtends the angle of 80 degrees of light radiating from the arc *A*, and which condenses the angle of light *L L* into the nearly parallel beam *P P*. As the light from the arc *A* is radiated in every direction, the dotted portion of the circle shows that 280 degrees of the radiant light is lost, and as these are the degrees of a sphere it will be seen that the mirror *M* intercepts and utilizes only about one-tenth of all the light radiated from the arc, and the barrel-shaped housing *B B* smothers or prevents most of the other nine-tenths from escaping into the space about it and thereby of diminishing the effects of the parallel beam *P P*.

The candle power used in those search lights is estimated at about 26,000, the one-tenth of which would be 2,600, showing a loss in the actual dynamo power produced of 23,400 to obtain an actual candle power of 2,600. It is, therefore, obvious that the catoptrical instrument used is practically a failure and that an instrument which would utilize all the rays emitted from the arc would give a ray ten times as brilliant as that now obtained. It is estimated that a mile is the greatest distance that those naval search lights will reach with satisfactory results; but if the whole dynamo power could be utilized it follows that they would reach three miles with a greater degree of illumination than they now do one. These facts make it evident that, however perfect may be the electrical part of the apparatus, the optical or catoptrical part is still very defective.

At the beginning of the arc light system, search lights were constructed, and were first used on river steamboats. The brilliancy of the illumination which they cast ahead of the vessel was considered so valuable, that for a while the outlook was quite promising, but as they were merely an arc light placed in the reflector of a locomotive headlight, the light which spread out of their mouths dazzled the pilots coming in the opposite direction. On the Mississippi this often involved a 10-mile stretch of water between two boats, where both pilots had to "go it blind," taking their chances of snags, until they passed each other, but as accidents not infrequently occurred it soon became a question

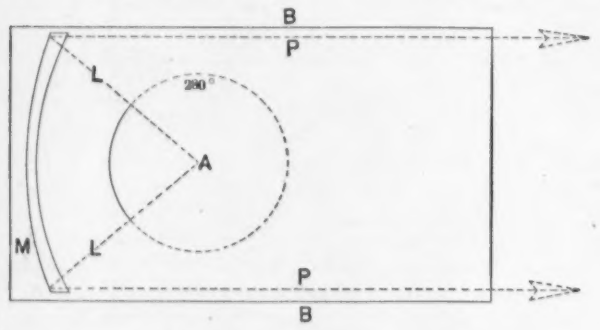


Fig. 1.—Diagram of Present Search Light.

whether such a light was of advantage or not. On this account their use decreased to a small percentage of what it had been. The condensed central beam was always of value, but the "flaring" light surrounding it more than neutralized its usefulness. They were introduced on the James River under the impression that as that river was narrow and crooked they would be just the thing for its navigation; and they *were*, so far as the navigation of the *river* was concerned, and if all the boats could have run in the same direction at the same time, these search lights would have actually obviated all the dangers of night navigation; but as different boats must of necessity move in opposite directions at the same time, they became mutually destructive of each other's safety, and the accidents of running ashore by the blinding effects of the "flaring," overbalanced the advantages conferred by the brilliant central ray. A great variety of experiments were tried, in the hope of extinguishing the flaring light while retaining the full vigor of the condensed central ray, but none of them succeeded.

The next effort to utilize electric search lights was on railroads, but the same difficulties were encountered there as upon the water. The flaring light not only blinded the engineer coming from the opposite direction, but its superior brilliancy beyond that of the signal lamps, hung on the cross-truss above switches and other places of danger, dimmed their red and green lights to invisibility. Many and various efforts were made to get rid of the flaring light and leave the central ray intact, but up to the present time they have all failed. In some of the recent literature upon the subject a claim has been put forth that the flaring light turns out to be an advantage because it illuminates the field of the night sky to so great a height that the position of the coming train can be seen from stations twelve miles away, like the dawning of the day. While admitting that this is a generous effort to make the best of the situation, one cannot help thinking that it bears a resemblance to that of the sportsman who, when the horse he had bet on came out last in the race, still cheered for him and called out in triumph to the bystanders to notice how he drove them all before him.

The object of a search light for a ship of the mercantile marine is to search in front and to the right and left of its own advance, and at the same time display such a signal as will show to other vessels its own position. A mercantile marine search light, therefore, should be so constructed as to search and signal at the same time. Those now in use can only search and signal alternately; they are, therefore, in the attitude of a sentinel set to guard two passes by which an enemy may approach, and while he is guarding one the enemy enters by the other. The accompanying diagram, Fig. 2, however, shows an instrument which guards both

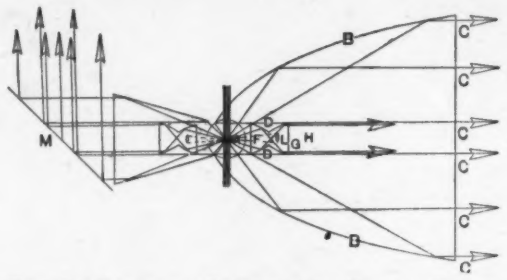


Fig. 2.—Combined Search and Signal Light.

passes at the same time. *A* is the position of the arc, *B B* a reflecting surface which casts the light, incident upon it from *A*, in the direction of the arrow headed beams *C, C, C, C, C, C*. The hourglass-shaped reflector *D* posed centrally in the greater reflector *B B* is so placed as to intercept all the light which would, in its absence, escape from the mouth of the greater reflector *B B*, and thence form the "flaring light" which now blinds the pilots on river boats and the engineers on locomotives that are approaching each other from opposite directions. The light radiating from the arc *A* which enters the hourglass-like reflector *D* is first reflected by the inner segment *F* of that little instrument, through the aperture between *D* and *D*, whence it falls on the reflecting surface of the outer segment *C* and is reflected by it into the parallel beam *H*. The small lens *L* refracts into parallel rays that which is radiant from the arc *A* and divergent through *D D*. By this arrangement it will be seen that all the light radiant from the arc *A* and contained within the angle of 256 degrees, as shown by the dotted line surrounding the arc, is changed by the co-ordinate reflecting surfaces, in unison with the small lens *L*, into a single parallel beam without any flaring light whatever.

We have here, then, an angle of 256 degrees of radiant light changed into a single parallel beam as opposed to an angle of 80 degrees now utilized by the best search lights in use, and we still have to spare an angle of 104 degrees, as may be seen by the rear portion of the dotted circle. Now as the square of 80 (the number of degrees now utilized) is 6,400 and the square of 104 is 10,816, it is obvious that the spare light still left to this instrument is to 80 as 1.69 is to 1.00, or about two-thirds more light than what is now utilized by the naval search light; so the signal beam alone in the new instrument is one and two-thirds times brighter than the searching beam of what is assumed to be the best search light now in use and the beam of the searching light nine times as bright.

As the small or rear end of the instrument is only a repetition of the large or front end, modified only in the curvature of its reflecting surfaces in response to its different relations to the source of light, we need not describe it, especially as the lines show the different directions given to the rays by the reflecting surfaces from their departure from the arc *A* to their final exit from the mouth of the instrument as a parallel beam, after which it is intercepted by a plain mirror *M*, which reflects it into the perpendicular position and at right angles to the searching beam. This gives a column or plume of light rising perpendicularly from the ship. As the instrument has a horizontal motion throughout the entire circle, the horizon can be constantly swept by the search light while the plume or signal light remains perpendicular. All the marine search lights used up to the present are so mounted as to pass from the horizontal in searching to the perpendicular in signaling, but the new instrument having only a motion about the horizon is controlled by the hand on an ordinary valve ring handle, while for naval signaling a motion given to the plain mirror *M* will sway the perpendicular beam from the zenith to the horizon, thus making room for a whole code of signals.

The appearance of a ship with both search and signal lights in use at the same time is represented by diagram 3;

as this would be the same in the case of a locomotive headlight the signal plume above the train could easily be seen at the distance of 20 or 30 miles, thus perpetually telegraphing its location upon the road in advance of its coming and thereby obviating the chances of such accidents as now grow out of the absence of such forewarnings, and as there would be no flaring light in the instrument the condensed beam could be so directed that its upper edge would pass below the eye of the engineer approaching from the opposite direction, in which case he could see the effects of its illumination on the track, before him, without being blinded by its light, as the light is dazzling only when it enters the eye directly in the line of its source, so that the light of such an approaching headlight would be a benefit to the engineer approaching it instead of being, as it now is, the means of dazzling him into a condition which is equivalent to blindness, for the time being; neither could such an instrument obscure the signals above the track, as its light would all pass under them.

COAST DEFENSE SEARCH LIGHTS.

The climax of power in search lights is reached, however, in what the writer has designated as a battery of lights for coast defense purposes. It consists in arranging a number of arc lights in the same order as a battery of artillery while in the act of battering down the wall of a fortification; all the guns are "trained" upon the same spot and discharged as nearly as possible at the same instant; then the blow delivered is as much greater than the effect produced by a single gun as there are guns in the battery, and as the force of the blow can be increased by every additional gun it follows that the blow delivered can be made simply resistless. Now, if an analogous battery of arc lights be directed to or at the same distant object, it is clear that it would illuminate that object to a condition of brightness as many times more luminous than the light of a single lamp would do as there were lamps in the battery. Thus, if with one lamp, say of 2,000 c. p., we could read ordinary print at the distance of a mile, then with four such lamps we could read it at the distance of two miles, and with 16 lamps at the distance of four miles, and so on. This would be the order, as the decrease in the intensity of light is inversely proportional to the square of the distance, but the power of penetrating distance would be increased by the successive increase in the number of lamps just the same as the power of penetration of the blow delivered by the battery of artillery would be increased by the addition of other guns.

It is understood, of course, that a battery of arc lights would be hooded, each by an instrument which would condense all the light radiant from the arc into a parallel beam, and all these being directed into one, while this great compound beam would have, practically, no greater spread than any single one of its components, as may be seen by the accompanying diagram 4. *B* is a battery of six lights and *C D* an object aimed at, and the diagram makes the result so self-evident that we need not discuss it, neither need we describe a mode of mounting such a battery to give it a motion about the horizon, as that could be devised by any mechanic.

The purpose of this arrangement was to produce a light for coast defense purposes, that would make it impossible for an enemy's ship to steal into a harbor under cover of darkness, or to prevent the possibility of night attacks on land.

The attention of General Abbott was called to this instrument when he was in command of Willets Point, and it so impressed him that he made the proposition to furnish a 10-light dynamo if the writer would supply the optical

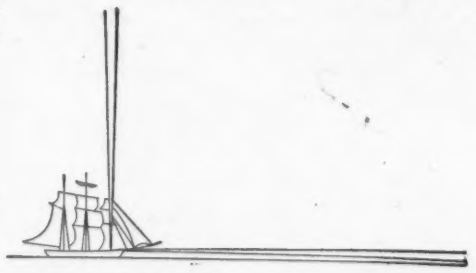


Fig. 3.—Use of Combined Search and Signal Light.

apparatus required, but as there was a slight difference between the amount of the surplus cash on hand in the respective treasuries of Uncle Sam and "the party of the second part," the latter was compelled to forego the pleasure of "foregathering" with that venerable gentleman, but General Abbot has generously placed the papers on file, in order to secure priority of invention to the original designer.

There are several advantages gained by using such a battery instead of a great carbon that might rate at as much candle power as all the smaller carbons put together. No means has yet been devised to remove all impurities out of these carbon electrodes, and it is these impurities which cause the arc light to "sputter" and go out at times, when a particle of iron, or whatever it may be, gets between the carbons. The larger the carbon is, the greater is the number of these impurities it contains, and as every one of them can be eliminated only by passing through the arc, it follows that the larger the carbon the more frequent is the "sputtering," and the oftener the light will grow dim or be extinguished; but in the numerous small carbons, only one or two at a time will be affected, so that the beam

compounded of them all will be constantly up to or near to its maximum brilliancy, and any other form of accident happening to some of them would not materially affect the efficiency of the battery.

LIGHTHOUSE ILLUMINATION.

In the present advanced condition of lighting by electricity the mineral oil lamp, now so generally used for lighthouse purposes, is already relegated to the farthing candle catalogue, and must soon disappear altogether. The many wrecks—some of them appalling—which have happened within the limits of a few past years for want of proper lighthouse appliances, seem to have awakened apprehensions that the lighthouse system is not what it ought to be, and a proposition is made to do away with stationary lights and replace them with flash lights. The present flash light system is accomplished by an instrument known as the Fresnel lens. The elaborate nature of its superscientific construction may be understood from the fact that "a first order" instrument of this kind costs about $15,000, but the one of which a drawing is here shown will give a ray four times as bright and penetrating as that of the first order Fresnel lens, while it also accomplishes every other requirement of the French instrument, and its cost is very much less.

Concerning the flash light instrument referred to, its action need not be described, but it may merely be mentioned that it may be built to project to the horizon two, three, or four arms of light. Three, however, would probably be its standard of usefulness, as red, blue and white light are all the colors required for a flash light.

Indeed all important lighthouses ought to be furnished with the means of displaying one or more of the perpendicular rays of light previously described and in the use of electric lighting most if not all of the electrical energy required could be obtained from a properly constructed wind wheel, the power of which could be employed in charging a storage battery.

HIGH LIGHTING ON LAND AND SEA.

As the onward march of electric lighting is only begun it might be well to consider here its possible destiny in a department already entered, that of lighting from high towers, high buildings, or high poles. In the latter case, it is true that the sensitive æsthetic natures of New York politicians discovered that the high lighting which once illuminated some of the small parks of the city was inartistic.

But the time is not far distant when electric lighting will be done from high positions in this and other cities, not

FIG. 4.—BATTERY OF SEARCH LIGHTS.

only because it will reduce the chances of accident but it will be more economical than any system hitherto in use, for the simple reason that a very large percentage of the light emitted is now radiated into space and its benefits thereby lost. Indeed, an estimate of the loss of street illumination from the cause above presented would show a waste of nearly one and a-half times that which is actually utilized. To illustrate this let us examine a case of high lighting, as it is equally true of low lighting. In the accompanying diagram, Fig. 5, the point of radiation is assumed to be at *A*, and high above the plain. It is obvious that all the light radiant above the lines *B B* is wasted by being cast into space, where it illuminates nothing, and the only light utilized is that which is below the lines *B B*, and by measuring these two quantities we find that 160 degrees of the light radiant from the arc is utilized and 200 degrees wasted; and while the city fathers of New York are disturbed about hypercritical artistic effects they remain oblivious to the fact that for every $3.60 of the city's money paid out for electric lighting, $2.00 is actually wasted in an attempt to illuminate the planet Jupiter.

It is not merely that such lights can be so managed that all the light emitted from the arcs employed can be distributed over the plane surface beneath, the illumination of which was the motive of placing the light there, but it can be distributed in any form required, and it often happens that one or more directions of the plane to be illuminated requires an increase of brilliancy, in which case the light retrieved from space can be sent there in greater quantity than to other parts where lesser degrees of brilliancy are sufficient. Thus, if the light which was radiated into space from the high lighting apparatus which once stood in Union Square, New York City, had been retrieved and confined in its distribution to the limits of the Square, the illumination of that would have been at least three times as brilliant as it was made by the light which then fell upon it. An example of one of the instruments for such a purpose is here submitted (Fig. 6). *A* is the position of the arc, *B B* the reflecting surface, and *C* a focal point through which it directs a large portion of the rays. *D D* is a plane mirror which directs the rays incident upon it downwards at any required angle and at any required spread. The plane mirror in this case is bent at or near its centre, the object of this being to confine the light to the width of a narrow street while it spreads along the street to a much greater extent. *E E* is a reflector which intercepts the light which would flare out from the mouth of the greater reflector *B B*, and condenses its rays into the condition of approximate parallelism required for its proper distribution on the plane below after its reflection from the plane mirror *D D*. The rays proceeding from the curved mirrors are given various directions by modifications of the form of the reflecting surfaces from which they are cast, but whatever the compound nature of these curves may be care is taken that none of the rays reflected from these pass outside of the boundaries of the plane mirror *D D*. Care is also taken, in planning the design, to so shape the compound curves given to the reflecting surfaces that the final distribution of the light on the illuminated plane will be even and properly distributed. The lines radiating from

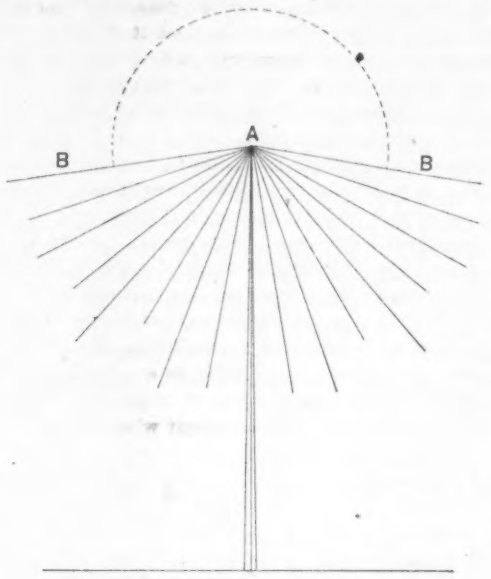


FIG. 5.—LIGHTING FROM A TOWER.

the arc *A* indicate the rays of light emitted, and by following their different reflecting surfaces we see how they impinge and also the direction of their different reflections, and by following those lines out to their final reflection from the plane mirror *D D* we see their final distribution indicated by the arrow-headed lines pointing downward. It is not to be understood that the forms here given are suitable for every requirement of distribution, because the designs must be made with special reference to the distribution of the light required on the plane surface to be illuminated, though perhaps about a dozen different designs would cover all the varieties of distribution required. In lighting from high towers or masts such as are now coming into common use in Europe, these instruments would be in groups as the arc lamps are now, and as each case would probably require different conditions of distribution the different instruments employed would require corresponding modifications of form.

THE FAILURE OF THE LIGHT AT HALLETT'S POINT.

A curious and somewhat expensive exhibition of failure in this kind of lighting was shown at Hell Gate a couple of years ago. An iron tower was built at Hallett's Point, and a number of arc lights placed on its summit for the purpose of so lighting the location of danger to navigation at and about its base that vessels passing through Hell Gate would have sufficient light to steer clear of the many dangerous rocks that beset that channel. When the light was turned on this part of the programme was fairly well accomplished; but the light also cast its beams to and above the horizon in every direction, and consequently into the eyes of pilots approaching the location of danger, from all of the three channels leading to it. This of course dazzled the pilots coming from and going to the sound, as well as those coming from the Harlem River, so that when the

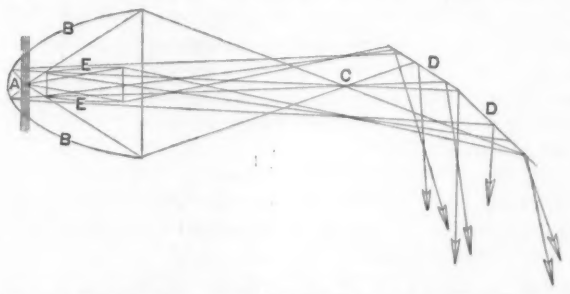


FIG. 6.—DEFLECTOR FOR ILLUMINATING A PARTICULAR AREA.

actual location of danger was reached, their eyes could not recover their normal condition of vision to see where they were going; but as they could not stop, they were forced to make their way through the location of danger as best they could without the assistance of light, and the consequence was that accidents were more frequent than before, until finally the pilots united in the demand that the light be discontinued, and the Secretary of the Treasury gave an order to that effect. As this order was not to take effect until one month after its issue, the writer sent a letter to the Secretary of the Treasury, asking the privilege of directing every ray emitted from the light upon the area of danger in the immediate vicinity of the tower, stating that the work would not cost the government a single cent, and that all he asked of this department was to draw a pencil mark upon the map inclosing the area of danger which it desired to cover with the light, and guaranteeing that every ray of light emitted from the arcs would be directed upon the space shown and evenly distributed over it, and that not a ray could enter the eyes of the pilots. Consequently they would arrive at the location of danger with their normal vision unimpaired, and unconscious of the presence of any light excepting that which lay upon the water, and rocks before and around, and that would affect the pilot precisely as the light from a shaded desk lamp affects the writer at the desk. This letter was sent to the Secretary of the Treasury in the very *slender* hope of dodging the red tape fiend, but, as the writer expected, it was referred to the Lighthouse Board and by that board to its secretary who was the person responsible for the failure, so the offer was declined on the ground that there was no appropriation, although it was accompanied with the statement that the government would not be called upon for a cent.

It is a great misfortune to navigation that the experiment at Hell Gate has been relegated to the catalogue of failures. It was not a failure excepting in the sense that there was not a man in the lighthouse department sufficiently acquainted with optical science to have made it a success. It was not the light but the man that was a failure. It is a phase of lighthouse engineering—when properly managed—of the most vital, indeed, one might say, fatal value to the navigation of every coast and entrance to many harbors, and it would not be difficult to enumerate many wrecks which have occurred for want of just such a method of lighting outcropping rocks which lie in or near the route of vessels making a harbor or navigating the coast.

THE PROPOSED SYSTEM OF RAILWAY LIGHTING.

For some time past there has been under consideration plans of lighting railroads by stationary electric lamps, placed at such a distance all along the lines of roads th at their lights will interlap, the supporting poles being about or above the height of those now used for street lightin g. In the event of such a condition of lighting it becomes obvious that the most economical distribution of the light would be along the tracks and only so far crosswise as to fully cover the road and as much beyond as the engineers think sufficient; as it would be of no advantage to illuminate the territory to the right and left. Now if all the light emitted from these lamps be distributed in this way the area of distribution would be very much brighter than if lighted by direct radiation only.

A moment's consideration will show that with such a

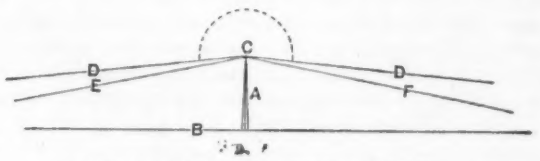


FIG. 7.—LIGHTING FROM A TOWER.

distribution half the number of lamps would make the field of illumination much brighter than double their number would do by direct radiation; consequently the cost of the latter system of lighting would be only half that of the proposed system, and to accomplish this a hood so constructed as to reclaim the waste light and give it the proper distribution would be all that was required. This actual distribution itself would be represented by diagram No. 7, *A* being the post, *B* the road bed, *C* the point of radiation and the place of the instrument retrieving from space all the light above the lines *D D* and distributing it in the manner shown by the angle *D E D F*, by which it will be seen that all the light retrieved from space falls at a distance remote from the lamp and beyond the area that is sufficiently illuminated by the direct radiation of the lamp.

It is also obvious that such an instrument would be equally useful in lighting docks and the shores of harbors generally, and would not only increase the illumination but entirely obviate the dazzling effect of blinding the pilots approaching their docks at night, and of which the complaints have been loud and long. Even for street lighting such instruments would be better and very much cheaper, if the cost be measured by the candle power obtained.

OPTICAL SCIENCE A BRANCH OF ENGINEERING.

The failure of the Hallett's Point tower light to accomplish the purpose for which it was erected; the failure of all efforts to extinguish the flaring light in locomotive headlights without extinguishing also the condensed central beam; the failure of the naval headlight system, which reduces them to the necessity of utilizing only one-tenth of the light emitted from the carbon, all go to prove that the required knowledge of optical science is not obtained by inspiration, and that without such a knowledge every attempt at the solution of a practical problem is only groping in the dark for that which in darkness does not exist. The examples previously submitted show that any prescribed curve which may be found in text books is entirely useless for the purposes there claimed, and they further demonstrate that electric lighting must, in the future, be associated with optical science, not merely with some prescribed curve, but with all manner of curves which are necessary to produce the varying effects required; therefore it is the effect which is to be produced which must determine the form of the curve, and if, from the effect to be produced, the designer has not the skill to construct the required curve then the effect sought for will not result. The science

of optics is a very important branch of engineering and a person can no more design in that branch without the necessary training than he could design a locomotive or an engine for a steamship without the training that conferred the knowledge required, and any attempt to do so will only bring with it the defeat and cost which the examples referred to have illustrated, and put further off such advantages as might have resulted to navigation from a success at Hallett's Point, or to safety of travel if locomotive headlights were properly designed.

Some Curves from Alternating Current Machines.

BY WARREN B. LEWIS.

The unusual number of experiments which have been made within a year or two upon the characteristic curves of currents as obtained from different types of dynamos, led the writer to attempt a few investigations in the same line, upon some alternating machines of special design. Taken in connection with preceding results, which have been published from time to time, they afford a most interesting study of dynamo electric machines of this class,

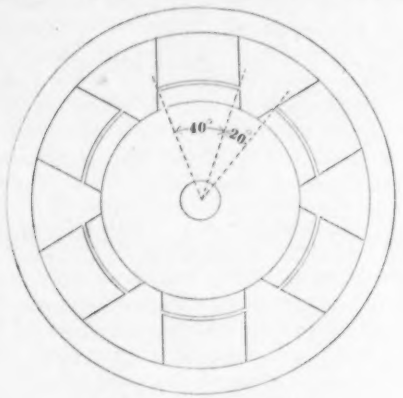


Diagram 1, "Type 60"

has imposed conditions, some of which, if understood at the outset, may lead to a better comprehension of the results which follow.

In the construction of the transformer, it has been found preferable, for many reasons, to make the secondary a large copper casting, which generally means a more or less solid mass of metal; but, in transmitting currents of several thousands of ampères, there is made evident the fact that the superficial area is of the greatest importance, and that the interior mass is of little use. This phenomenon being dependent largely upon the rate of alternations, the system could be made more efficient by using a low periodicity. The requisite induction in the armature wires can be obtained by causing a very rapid change in the magnetic circuit at some instant; and in the machines under observation this is so well done that only a remarkably small amount of wire is used. One would naturally expect that with an abnormal rate of change in the magnetic circuit at one point, that a slower change would occur at some other place, and that the result would be a curve rather far removed from the typical sine curve. How closely the theory is proved by practice will be seen by reference to the curves.

The periodicity adopted was 50 per second, obtained from four and six pole machines. The two machines which were principally used in the trials are both six pole, but of different designs as to the angular width of the pole pieces. The armatures of both are solid, with the exception of the ventilating holes, and have pole pieces corresponding to the field poles. The armature wire is wound in rectangular coils and put over the poles so as to surround them.

One machine, which will be designated as a "60," was a 60,000 watt dynamo of the composite type. A certain proportion of the armature current is commutated, and flows through the field wire in series with the current of a small exciter dynamo. The proportion commutated is dependent upon the ratio of the resistance of the exciting circuit to a shunt placed outside of the machine, and connected to a third collector ring.

ampères as marked. The position of the field poles with relation to the centre of the armature coil is also shown at the top and bottom of curves 1, 2, 3, 4, 5, 6, and by the dotted ovals in curve 7.

Curves 1, 2, 3 are of the type "60." The angular width of the pole pieces is shown in diagram 1 to be 40 degrees, and the space between them 20 degrees. The direction of rotation of the armature is indicated in each curve by an arrow.

In curve 1, the full line is the potential curve, the dynamo running on no load. The dotted curve is a sine, and is drawn to more forcibly illustrate the approach of the potential curve to a "saw tooth." The features which become noticeable are the regularity of the curve and its maximum E. M. F., which is about 468 volts: the working potential, as read on a Cardew voltmeter, being 296 volts, shown by a straight line. The field magnets required 386 watts, which were supplied by the small exciter alone, evidently.

Observe now curve 2. The dynamo is loaded on a water rheostat to a little over 52,000 watts, the field requiring 635 watts, or about 1.2 per cent. The regularity of the curve has been considerably disturbed, and the maximum point

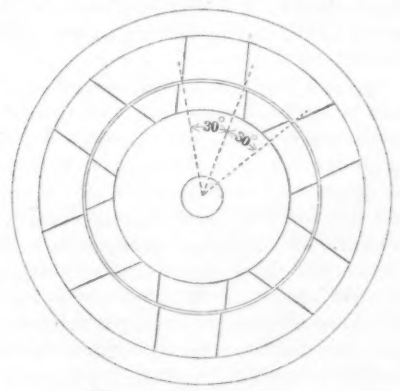
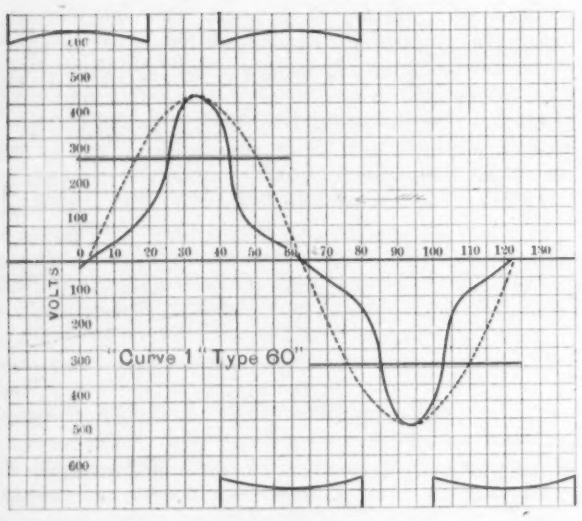
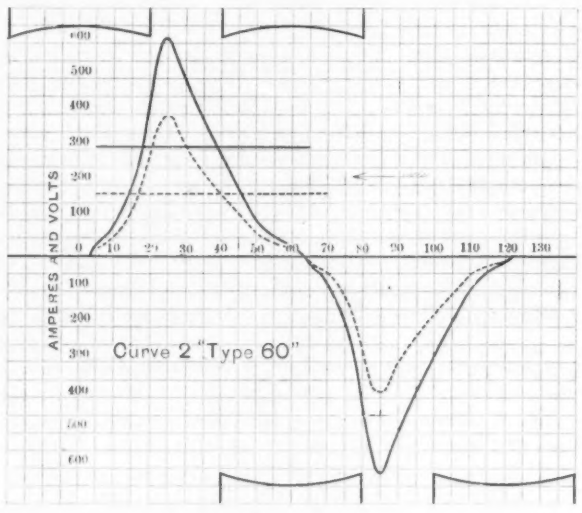
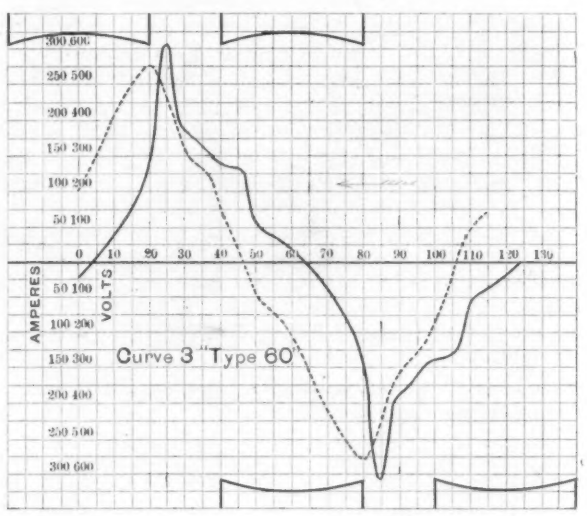
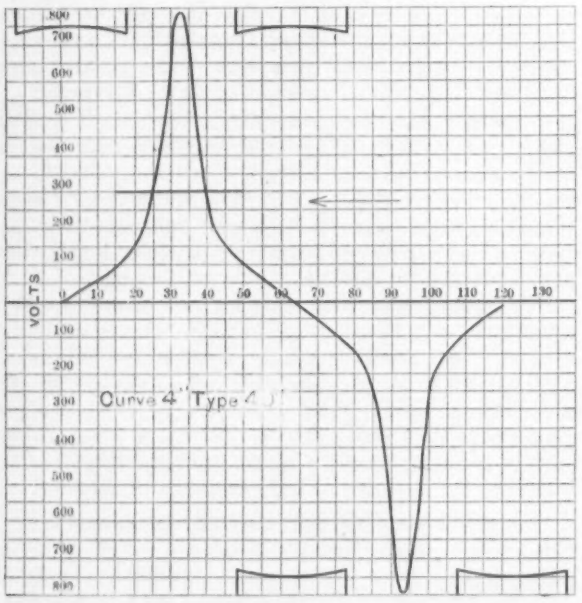


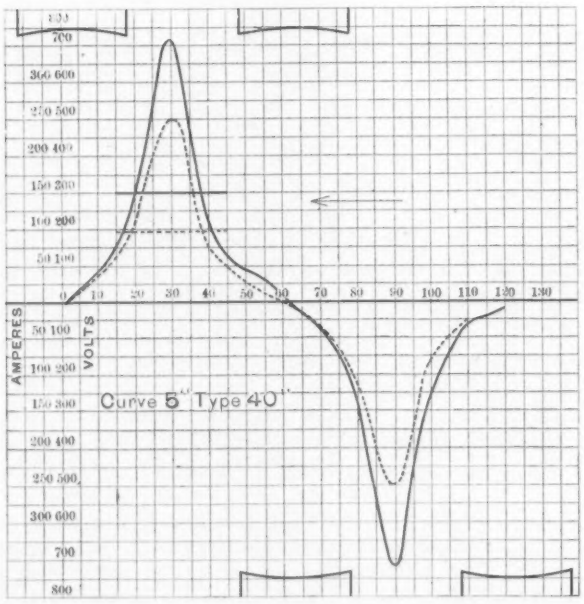
Diagram 2 "Type 40"

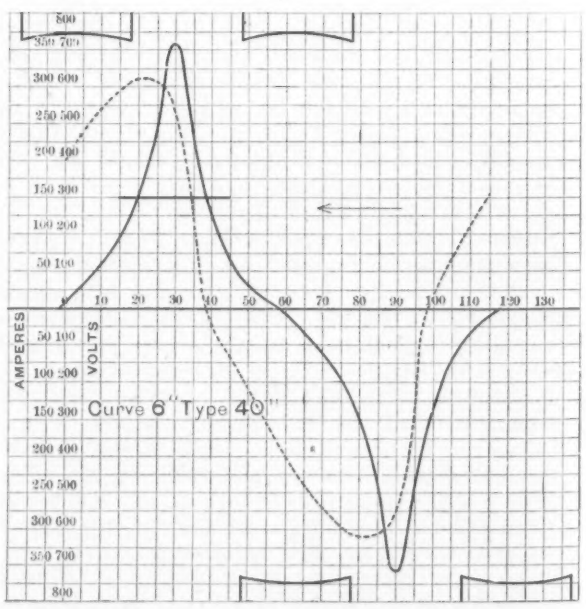












CURVES 1 TO 6 AND DIAGRAMS 1 AND 2.—CURVES SHOWING THE PERFORMANCE OF ALTERNATING CURRENT DYNAMOS.

and give a more or less complete record of the peculiarities which may be obtained by different dispositions of iron and copper.

The applications of alternating currents to methods of heating, smelting, and other processes in which currents of immense volume are employed, has led to a class of apparatus considerably different from that which is so generally known and used for lighting. In the transmission of these currents, obstacles have arisen, which have been satisfactorily overcome only after considerable experimenting. The adaptability of the transformer to such processes has led to a large number of interesting experiments and developments and has called for a dynamo to be used in connection with these transformers which possesses peculiarities not found in other types.

A combination of mechanical and electrical requirements

Another machine was a separately excited dynamo, rated at 40,000 watts, and will be designated as a "40." This machine differs from the preceding in the angular width of the pole pieces and the shape of the grooves in the armature core. The third was a separately excited alternator, the armature having no iron, and will be designated as a "50."

In connection with each set of curves a small diagram is given, showing the relative dimensions of the various parts, and their angular positions. A description of the apparatus used is hardly necessary, as the same arrangements have been described in previous papers. The galvanometer was a ballistic one, designed and constructed for the occasion, and gave excellent results.

In all the curves, the abscissæ are actual degrees about the shaft of the machine, and ordinates the volts and

has reached 615 volts, while the working potential has increased but 8 volts to 304. The dotted curve is the current curve, the straight dotted line the current as read on an ammeter, both drawn to the same scale as the potential curve. This makes rather a curious curve when compared with curve 1, but graphically illustrates the change in the magnetic circuit very clearly—the sudden jumping away from the armature of the magnetic lines from the receding poles, and the leap to the armature of the lines from the approaching poles. But the peculiarity becomes greater when the load is an inductive one. Curve 3 is such a load, the actual power being 34,500 watts. The maximum E. M. F. is the same as when a non-inductive load was used, and the side of the curve in the direction of rotation is not greatly changed; but the remaining part of the curve baffles description. The current curve is quite regular, and

approaches a sine curve, which is what an inductive load tends to produce, as is well known. The field magnets use 826 watts, or 2.4 per cent of the output.

Referring now to curves 4, 5, 6, we see the effect of narrowing the pole pieces. This machine is the type "40," and the pole pieces, as shown in diagram 2, are but 30 degrees in width. The working potential being practically the same as in the case of the "60," namely 300 volts, the maximum attained is 790 volts, with a position exactly midway between the poles, and very rapidly falling off, about equally on either side. It may be interesting to note the matter of insulation which this curve brings out. Although 300 volts is the working potential, the machine should be insulated for 800. As a fact these dynamos are now insulated to withstand a potential of 1,800 volts.

Curve 5 represents a non-inductive load of 34,000 watts, the fields using 936 watts. The angular position of the maximum point has advanced, but the regularity is still preserved, with the exception of a few degrees near the zero line on one side. The curve has broadened, too, with a consequent drop in the maximum E. M. F. As would naturally be expected, the current curve follows the potential

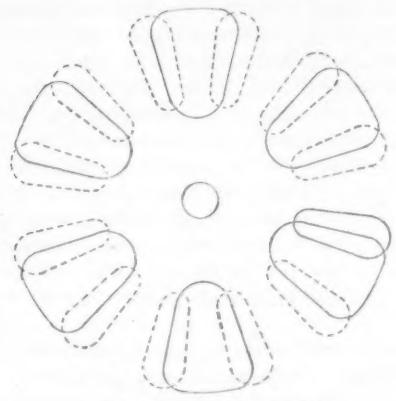
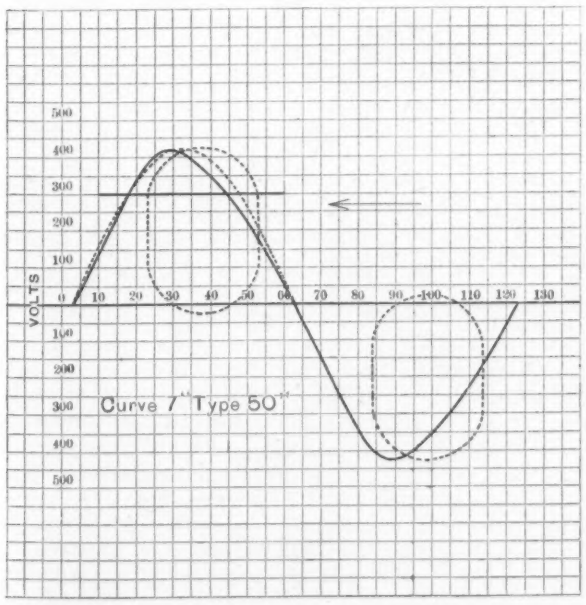


DIAGRAM 3.—PERFORMANCE OF ALTERNATING CURRENT DYNAMOS.

curve very closely. Curve 6 was taken when the dynamo was loaded with an inductive resistance, the same as in curve 3. The actual power was 37,000 watts, with 1,140 used in the fields. Notice that the current lags somewhat more than in the "60."

Curve 7 was made principally to show how far removed in character two machines of so different design could be. Diagram 3 shows the relation of armature and field, the dotted ovals being the field poles, and the full lines the armature coils. The dotted curve in curve 7 is a sine and serves to show how near the curve of the dynamo in question approaches it. Compare this with curve 4, and a greater difference could hardly be imagined.

Unfortunately, at this point, circumstances prevented the continuation of the experiments, and it is a matter of regret that further curves could not be taken on the last machine. A few rough experiments were made to deter-



CURVE 7.—PERFORMANCE OF ALTERNATING CURRENT DYNAMOS.

mine the reaction of an armature pole upon a field pole, when the dynamo was carrying its full load, but the effect was so small that special arrangements would have had to be made, and for lack of opportunity the work was discontinued.

A very interesting study may be made by recalling the curves made by Messrs. Tobey and Walbridge,* on the "Stanley Arc Alternating Current Machine," and comparing them with those given in the preceding.

It may not be out of place to add that the two machines upon which the foregoing experiments were made are very efficient and well suited to the purpose. Loads, up to their full capacity, are thrown on and off at brief intervals, with no difficulty, and with hardly a noticeable change in the potential.

* See THE ELECTRICAL WORLD, Nov. 8, 1890.

The Elements of Practical Electricity.*

BY DR. LOUIS BELL.

HOW ANGLES ARE MEASURED.

Before we are ready to look into the action of the earth's magnetic force on a suspended needle we must learn in what terms we are to measure the angles through which the needle is deflected, for such measurement will appear at intervals throughout the discussion of various problems in practical electricity.

Draw a circle as shown in Fig. 19 and from its centre draw two lines perpendicular to each other, the angle between them is known as a right angle, and when any two straight lines cross or meet one another there will be included between them a greater or less angle, depending on their relative positions. For many centuries it has been the custom to divide the entire circumference of a circle into 360 parts known as degrees, and a glance at the figure will show you that two radii perpendicular to each other will be one-fourth of this, or 90 degrees apart, a radius drawn half way between the two will form an angle of 45 degrees, and so one might go on cutting up the circle into parts indefinitely small. The figure shows a series of angles reckoned in this way. The angle *b O a*, for example, is one of 15 degrees, while *c O a* is an angle of 30 degrees. All this is very elementary and simply expresses the commonest method of angular measurement. If a circle divided as shown were laid down under your suspended magnet you could by looking down upon it measure roughly the amount of deflection, and with a fine needle and a circle divided not into 15 degrees, as in the figure, but into 360 degrees, you could measure the position of the needle with reference to its original direction and its direction when drawn aside by the action of a magnet or a current quite accurately. There are, however, other ways of expressing angles, not quite so simple at first sight, but for certain purposes very much more convenient. A considerable number are encountered in trigonometry, and

FIG. 19.—RECKONING ANGLES BY DEGREES.

a couple of the commonest may be very readily explained here.

RECKONING ANGLES BY SINES OR COSINES.

Fig. 20 shows how this is done. We have here as in the preceding figure divided a right angle—what is known as a quadrant of the circle—into angles of 15 degrees. Having done this we have drawn dotted lines from the point where each radius mests the circumference of the circle perpendicular to the two lines at right angles originally laid down. Now taking the angle *a O A* we can either define it as being 15 degrees, or we can reckon it in terms of the line drawn from the extremity of the radius perpendicularly upon the line *A O*; as the angle gets larger and larger the length of this line will steadily increase until when the angle is 90 degrees it will coincide with the radius. Its length can evidently be as great as 1 and will be smaller and smaller as the angle grows less. It is customary in this method of measuring angles to count the length of this line not in inches or feet but as being a certain fractional part of the radius. In fact, the ratio between the length of the line *a f* and the radius is what we use to measure the angle, and that ratio is known as the sine of the angle. So, taking any angle whatever, its sine is always the ratio between the perpendicular dropped from the point where the radius cuts the circle and the radius itself. If we have a circle of unit radius, one centimetre, one inch, or one foot, or whatever else you please, the length of that perpendicular is the sine of the angle and enables us to define the size of the angle very accurately. For example, we can say of an angle that is one-third of a right angle, either that it is of 30 degrees or that it is the angle the sine of which is one-half, and in the same way an angle of 45 degrees would be the angle whose sine is .7. You will see, of course, that because the sine of 90 degrees reckoned in this way is unity then by increasing the angle still further we shall get not a larger sine; in other words, all the values that it can have are less than 1, and we could never have, for example, an angle whose sine is 3½. In a precisely similar way taking our original angle *a O A* the line *a k* is called the cosine of the angle in question, and we can evidently define an angle in terms of lengths of this cosine just as well as by the length of the sine. For instance, an angle of 30 degrees can be defined as the angle whose sine is a half, or as the angle whose co-

* Continued from THE ELECTRICAL WORLD of Nov. 7, 1891.

sine is .86. If you turn the diagram, Fig. 19, around 90 degrees you will see that the cosine of 30 degrees is exactly the same thing as the sine of 60 degrees, and so on for all other angles; the cosine of any angle being the sine of 90 degrees less that angle. Therefore no sine nor co-sine can ever have a value greater than 1 as compared with the radius. By drawing the sines and cosines of a few specimen angles you will readily learn their relation to each other.

RECKONING ANGLES BY TANGENTS.

But there is still another way of reckoning angles, with which we have to do in electricity. Draw a circle as before, and also an angle formed by two radii, as in Fig. 21; prolong one radius to some distance beyond the circle, and just where the other cuts the circumference of the circle draw a line at right angles to it, prolonging it upward until it cuts the line previously drawn. The line *d O* will be what is known as the tangent of the angle *d O a*, being the length of the line touching the circle at the extremity of one radius, and drawn perpendicular to it until it meets the other radius. We can then define the angle either as of 45 degrees, or as the angle whose tangent is 1. Small angles will have very small tangents, but large angles will have very large tangents indeed, as you can easily see by trying to draw

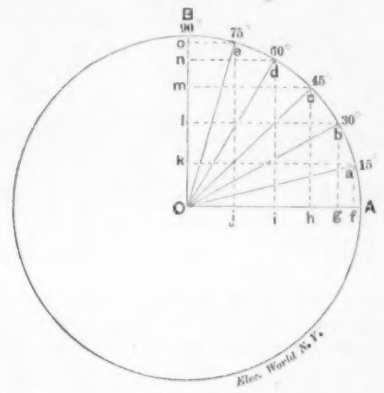


FIG. 20.—REOKONING ANGLES BY SINES OR COSINES.

the tangent for an angle of 75 degrees. If you attempted to draw that for 90 degrees you would find the tangent would go on indefinitely without ever meeting the radius at all—in fact, it would be an indefinitely long line, so that while the sine of any given angle must be less than 1, the tangent need only be less than infinity. We may define the tangent as the ratio between the length of two lines, just as we defined the sine. In this case the tangent of the angle *d O a* equals the ratio between *d a* and *O a*, or if we simply define it in terms of the length of the radius, it is equal to the line *d a*, in this case unity. There happens to be an interesting relation between the length of the tangent of any angle and the length of the sine and cosine of the same angle. If you take any triangle like that formed by the three lines *d O*, *O a* and *a d* and then draw a line like *f g* parallel to one side of the triangle, the other two sides are divided proportionately. In other words, the length of the line *d a* divided by *O a* would have exactly the same value as the length of the line *f g* divided by *O g*. In the

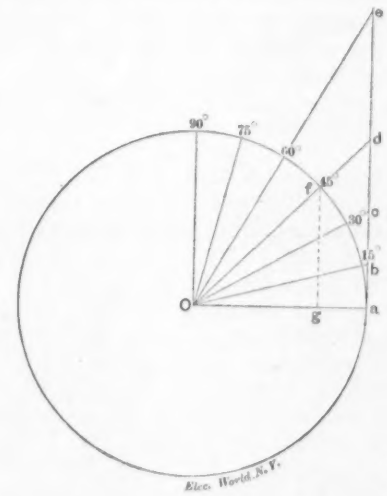


FIG. 21.—RECKONING ANGLES BY TANGENTS.

particular case we have chosen, both ratios will be unity. You can easily verify the truth of the statement in case you are not familiar with geometry, by drawing the lines, measuring their lengths accurately and performing the divisions indicated. But *f g* is the sine of the angle of which *d a* is the tangent, and *O g* is precisely equal in length to its cosine, so that we can say in general that the tangent of any angle is equal to its sine divided by its cosine.

We have now described four distinct ways of measuring angles, for instance the angle that is equal to one-third of a right angle we may reckon as of 30 degrees, as the angle whose sine is a half, the angle whose cosine is .86, or the angle whose tangent is .57. All these ways have their own individual and particular uses, sometimes one is more convenient and sometimes another, although for most purposes we use simple angular measurement by degrees. For certain purposes either the sine, cosine or tangent may be more convenient.

There are conventional ways of writing down angles in

these various ways of reckoning, used simply for convenience to save writing several words. As an example, an angle of 30 degrees would, according to the several methods of measurement we have mentioned, be written as follows:

$$30^\circ$$
$$sin^{-1} = .5$$
$$cos^{-1} = .86$$
$$tan^{-1} = .57$$

The last three notations would be read like this: "The angle whose sine equals one-half," etc., sin, cos and tan being respectively the abbreviations for sine, cosine and tangent.

A table of the values of the sines and tangents of each degree from 0 to 90 is appended. The cosines may be found simply by remembering that the cosine of any angle is the sine of 90° less that angle.

TABLE OF NATURAL SINES AND TANGENTS.

Arc.	Sine.	Tang'nt.	Arc.	Sine.	Tang'nt.	Arc.	Sine.	Tang'nt.
0°	0.000	0.000	20	.342	.364	80	.985	5.671
1	.017	.017	25	.423	.466	81	.988	6.314
2	.035	.035	30	.500	.577	82	.990	7.115
3	.052	.052	35	.574	.700	83	.993	8.144
4	.070	.070	40	.643	.839	84	.995	9.514
5	.087	.087	45	.707	1.000	85	.996	11.43
6	.105	.105	50	.766	1.192	86	.998	14 30
7	.122	.123	55	.819	1.428	87	.999	19.08
8	.139	.141	60	.866	1 732	88	.999	28 64
9	.156	.158	65	.906	2.145	89	.999	57.29
10	.174	.176	70	.940	2.747	90	1.000	Infin.
15	.259	.268	75	.966	3.732			

We are now ready to go on to the investigation of the angular deflections of a magnet, having found out how to measure the angles with which we have to deal in various useful ways.

(To be continued.)

(Copyrighted, 1890.)

Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1782.——Nairne (Edward), an English mathematical instrument maker, publishes papers on electricity describing his invention of a cylinder machine which is illustrated and described at page 15 of the chapter on electricity in "Library of Useful Knowledge," 1829, and in which appear all the essential parts of the frictional apparatus now in use.

According to Cuthbertson, this machine was originally constructed in 1774, and was far more powerful than any before made. Nairne also constructed the largest battery known up to that time. It contained 50 square feet of coated surface, and it could be given so high a charge as to ignite 45 inches of iron wire 1-150 of an inch diameter, which was then the greatest length of wire ever ignited. Mr. Nairne improved upon some of Priestley's experiments. He found that a piece of hard drawn iron wire, ten inches long and one one-hundredth of an inch diameter, after receiving successively the discharge of 26 feet of coated glass (nine jars) was shortened three-fortieths of an inch by such discharge. Dr. Priestley had previously observed that a chain 28 inches long was shortened one quarter of an inch after having had transmitted through it a charge of 64 square feet of coated glass, and Mr. Brooke found that by passing a charge of nine bottles of 16 feet of coated surface nine times in succession through a steel wire 12 inches long and one one-hundredth of an inch diameter, the wire was shortened one and one-half inches, or one-eighth its entire length.

To Mr. Nairne was granted the third English patent in the Class of Electricity and Magnetism, the first having been issued to Gowin Knight in 1766 (see A. D. 1746) and the second to Gabriel Wright, June 25, 1779, for "a new constructed azimuth and amplitude compass." Knight subsequently covered other similar inventions, July 5, 1791, and Jan. 19, 1796. Mr. Nairne's patent bears date Feb. 5, 1782, No. 1,318, and is for what he calls "The Insulated Medical Electrical Machine," the conductors of which are so arranged as to readily give either shocks or sparks. He says that "by means of the conductors and jointed tubes, the human body can be in any part affected with either kind of electricity in any convenient manner."

See *Philosophical Transactions* for 1772, 1774, 1778, 1780, 1783; Cuthbertson, "Practical Electricity," London, 1807, pp. 165-168; article "Electricity," in the "Encycl. Britannica;" "Description of . . . Nairne's . . machine," London, 1783 and 1787; Caullet de Veaumorel, "Descrip . . . ," Paris, 1789; Delaunay's "Manuel, etc.," Paris, 1809, pp. 7, 12–14.

A. D. 1782–1791.——Cassini (Jean Jacques Dominique, Comte de) son of Cassini de Thury, eminent astronomer, makes the important announcement that, besides the *secular* variation of the declination, the magnetic needle is subject to an *annual* periodical fluctuation depending on the position of the sun in reference to the equinoctial and solstitial points.

Cassini's discovery is contained in a Memoir consisting of two parts, the first being a letter addressed to Mr. L'Abbé Rosier and published by him in the *Journal de Physique*, while the second part, composed at the request of the Académie des Sciences, is that which specially treats of the *annual variation in declination*.

Besides the last named, we have thus far learned of the *secular* variation discovered by Gellibrand (Hellibrand) in 1635 as well as of the *diurnal* and *horary* variations, first accurately observed by George Graham during the year 1722, and we have likewise been informed of the earliest observations of *the dip or inclination*, made independently by both Georg Hartmann (A. D. 1543–1544) and by Robert Norman (A. D. 1576), as well as of the determination of the intensity of the inclination by J. C. Borda (A. D. 1776). For accounts of the *secular* and *annual*, as well as of the *diurnal* and *horary* variations of the dip, the reader should consult the First Section of Humboldt's "Cosmos" treating of telluric phenomena and some of the very numerous references therein given.

Speaking of the influence of the sun's position upon the manifestation of the magnetic force of the earth, Humboldt remarks that the most distinct intimation of this relation was afforded by the discovery of *horary* variations, although it had been obscurely perceived by Kepler, who surmised that all the axes of the planets were magnetically directed toward one portion of the universe. He says expressly "that the sun may be a magnetic body, and that on that account the force which impels the planets may be centred in the sun" (Kepler, in "Stella Martis," pp. 32–34—and compare with it his treatise, "Mysterium Cosmogr.," cap. XX., p. 71). He further observes that the *horary* variations of the declination, which—although dependent upon true time, are apparently governed by the sun, as long as it remains above the horizon—diminish in angular value with the magnetic latitude of place. Near the equator, for instance, in the island of Rawak, they scarcely amount to three or four minutes, whilst they are from thirteen to fourteen minutes in the middle of Europe. As in the whole northern hemisphere the north point of the needle moves from east to west on an average from 8½ in the morning until 1½ at mid-day, while in the southern hemisphere the same north point moves from west to east (Arago, *Annuaire*, 1836, p. 284, and 1840, pp. 330–358). Attention has recently been drawn, with much justice, to the fact that there must be a region of the earth, between the terrestial and the magnetic equator, where no horary deviations in the declination are to be observed. This fourth curve (in contradistinction to the *isodynamic*, *isoclinic* and *isogonic* lines, or those respectively of equal force, equal inclination and equal declination), which might be called the *curve of no motion*, or rather *the line of no variation of horary declination*, has not yet been discovered.

* Continued from THE ELECTRICAL WORLD of Nov. 7, 1891.

The Electric Motor in Mining.

The partial use of the electric motor in developing the mining industry would seem to be an assured success, as reports in regard to recent trials made by those interested in mining development in different parts of the country confirm the claims made, that the use of the electric motor makes development cheaper and that it is entirely practicable in operating mining machinery. One of the most enthusiastic exponents of the use of the electric motor for mining purposes is Mr. C. E. Hart, superintendent of the Southwestern Electric Light and Water Power Company, of Joplin, Mo.

Mr. Hart first demonstrated by public tests his claim, by using a 10-h. p. Thomson-Houston motor to operate a 10-inch pump at a mining shaft near Joplin, it being conceded that if the motor could run the pump successfully, it could operate any machinery in or about a mine. The test turned out to be a perfect success, and a company was organized, which recently purchased the plant and franchise of the Joplin, Mo., Electric Light Company, which included property at Grand Falls, near Joplin. Work was immediately begun upon an immense electric light and power plant at the falls, which has been erected under the direction of Mr. Hart. A dam was constructed, which furnishes power to run four turbine wheels of 500 indicated horse power each.

The electric plant is operated, furnishing the city and commercial lighting, running two arc light circuits and one incandescent, and the company, of which Mr. Hart is now superintendent, is rapidly developing the idea which led to its organization, namely, the furnishing of electric power to operate mining machinery, referring to which an exchange recently had the following: "The power has been applied at shaft No. 31 on the Empire ground. A 7½-h. p. motor is used to drive the hoist and it lifts the heavy tubs filled with rock and ore and dirt out of the shaft with an ease and speed quite unusual. The advantages of the electric motor are several. No large building is required to house it, one experienced man can look after eight or more of them, there is no danger in their use, there is no dirt or annoyance from fuel, water and smoke, no fires to tend, and moreover the mine operator is not required to tie up $600 to $2,000 in machinery which is constantly deteriorating and which entails every year a large expense bill for repairs. Electric motors of 10 h. p. can be furnished at a cost not to exceed 5 cents per horse power per hour, and as the capacity of the motor is increased the cost per horse power is decreased. A 30-h. p. motor could be operated at a cost to the miner of 2½ cents per horse power per hour, and this cost includes the salary of an experienced man to look after it. The mine operator is simply required to pay for the use of the motor; the company pays all the expense of operating. It now has a 100-h. p. generator in use, and room is provided for as many others as may be required. The work of the motor at shaft No. 31 will be watched with interest, and the company is confident that as its merits become known there will be a demand for all the motors that can be furnished. The power plant enterprise of the company is bound to be a potent factor in developing the mining industry, for the reason that the use of the electric motor will make development cheaper."

The Western Union's New Operating Room Nearing Completion.

The first division of what will be the greatest system of telegraphic switchboards in the world, says Sunday's New York *Recorder*, has just been placed in position at the Western Union Building. The frames of four other divisions, all iron and steel, are partly erected, and for the first time since the memorable fire of July 18, 1890, which temporarily wiped the great telegraph system out of existence, the immense operating room is assuming shape and form. But everything is changed, is different entirely from what it was before the fire and on a grander scale, so that an operator who had worked in the old room would not recognize this immense new apartment stretching along for over half a block toward Church street and fronting 100 feet on Broadway.

It will be some months yet before the music of the key is heard in the big room, and much remains to be done to put it in shape for business, but the work has at last progressed so far that the wires are being strung, and the management can see light ahead very plainly. When the last touch is finally given to the room, which is on the eighth floor, everything will be so arranged that the whole force will go to work at the new tables at once. With the last click on the press messages of the night before, the keys in the extemporized operating rooms on the fourth and fifth floors will be deserted for good, and the day force that comes on in straggling details will sit down in a body in the new quarters.

The change will be a most remarkable event in telegraphy, and pages on it will be written in all the scientific and electrical papers of the world. It had been expected by the company that the new operating quarters would be ready some months ago, but for one reason or another, strikes, brick boycotts, etc., there was much unexpected delay. When, however, the work is finally completed no one, not even the stockholders, will regret this delay, for business has been going on in the improvised operating rooms without a hitch, and by the added time given to the work of rebuilding the plans have been so altered as to provide for all the growth of business that may be expected for a quarter of a century to come.

In the remodeled building the company will have more than twice as much room for its operating plant as it had before, two entire floors being given up to the department, there being in reality two rooms of exactly the same size, one on the seventh and the other, the main room, on the eighth floor. Formerly one floor was occupied by the great battery room, but under the new system storage batteries have been done away with entirely, the electric currents being supplied by a system of 15 powerful dynamos in the basement.

A large section of the battery floor was also taken up until the conflagration by the "wire room," where all the wires ran in from the big racks on the roof to be conducted to the switchboard. It was in this room that the fire which worked such havoc originated, a bolt of lightning having, it is supposed, followed one of the wires into the room, igniting the insulation and setting fire to the whole network.

Under the new system there will be little or no danger from this source, for all the wires will enter the building by underground conductors, and the wire room, such as it is, will be located in the basement, where everything will be fireproof. After being taken to the switch connected with the dynamos in the cellar the wires will be carried upstairs in great cables, each carrying 100 wires, by means of an enormous fireproof flue, which runs beside the elevator from the cellar to the eighth floor. After reaching the top floor the wires will be distributed by a very ingenious system which has never before been employed.

The floors of both the seventh and eighth floor rooms are laid in cement resting on iron girders. Running the length and breadth of the rooms are several miles of narrow trenches about five inches wide and two and a half inches deep. They cut the floors up into squares on each of which will rest an operating table accommodating eight men. The wires in the room will be as completely covered as they are in the street subways, while in the old room they were all exposed, running along the ceiling.

Movable tops of rock asphalt will be put over the little trenches, so that a wire can be examined at any point without trouble. These tops will fit in snugly, and when down will look like the rest of the floor, which is all to be topped off over the cement with rock asphalt. By means of this system of carrying the wires the company expects to be almost absolutely safe from damage by fire, and further security will be given against the interruption of business from this source by the new system on which the switchboards are conducted.

Instead of leading all the wires to one board, as was done prior to the fire, and as the custom is to-day in all the big telegraph and telephone offices, the Western Union will have its switches divided into eight divisions, each set in a different part of the room. If, therefore, a fire should break out in one division despite all the precautions that had been taken to prevent it, the damage would be con-

fined to only a small portion of the wires. The divisions in the switches have been made according to locality and class of wires carried. There is a division for the East, one for the West, etc. Then there is a division for the local wires, special wires, and other branches of the service.

Besides the eight main divisions there is another switch, one of the most important of all, located on the site of the old board against the northern wall. It is known as the "loop system," and by means of it direct communication between any two points can be established. Every wire in the building connects with this "loop," so that direct communication can be established at an instant's notice.

Something like 1,700 wires will run into the new rooms, 800 trunk or through wires to the important points in the country and 800 or 900 city, suburban and leased wires. An operating force of about 700 men and women will constitute the day and night force—only a few more than are employed at present—but they will be able to work to much better advantage than has been the case for years. The old operating room, for a long time before the fire destroyed it, had been sadly cramped and overcrowded.

When it was built, some fifteen years ago, it was more than sufficiently large for all the demands made on it, but the business increased with such extraordinary rapidity that toward the last the operators were almost piled on top of each other during the rush hours. For this reason, and to leave lots of room to spread in, two floors instead of one were set aside for the transmission of messages, and beside this enlargement the big space of the new addition on Dey street was thrown into the new rooms.

When the rooms, especially the main room on the eighth floor, are finally thrown open for business they will present a most imposing sight, and constitute the largest operating rooms in the world. All the furniture will be of oak and mahogany. The operating tables, most of which are already in position, will have oak frames with mahogany tops, and with the glittering new instruments will make a fine showing. None of the paraphernalia now employed in the operating rooms downstairs will be moved to the new quarters. The instruments will be stored away for use in out-of-town, suburban and branch offices as they are needed from time to time, and most of the other material will probably find its way to the junk shop.

As soon as the operators move into the new rooms workmen will tear out the fixtures in the fourth and fifth floor rooms, and they will be arranged for use by the auditing and other departments of the company. The sixth floor, too, will be used as department offices, and the top or ninth floor will be used for Associated Press and miscellaneous purposes.

Electric Locomotives.

While electricity has been used for some time in mining work for the purpose of lighting mines, it attained no very decided prominence in the field of underground haulage until the Thomson-Houston Electric Company designed and installed the locomotive in the Erie colliery of the Hillside Coal Company, in October, 1889. Requirements of other mines, however, have led to the production of a locomotive differing essentially from that in the Erie colliery—a type known as the "Terrapin Back," which is shown in the accompanying illustration.

ELECTRIC MINING LOCOMOTIVE.

It is substantially and solidly built, the interior mechanism being entirely protected by a heavy iron armor, and possesses in a marked degree the important features of strength and solidity. The motor for operating the locomotive is of the iron-clad consequent-pole type, having a Gramme ring armature. It is provided with the radial type carbon brushes and elongated commutator segments, by means of which the most durable connection with the armature coils is obtained. The motor is situated midway between the axles, the proper speed reduction being attained by means of a train of gears. The locomotives can be run at various speeds, the motors being wound for any speed from four to ten miles an hour.

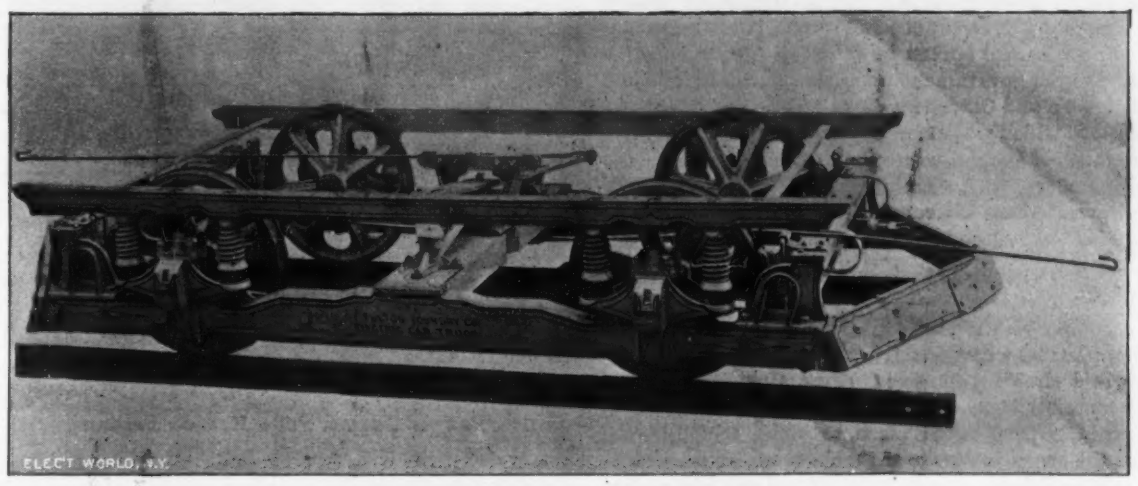
The locomotive is provided with the necessary controlling devices, all placed within easy reach of the operator. A special type of rheostat composed entirely of mica and German silver is employed, and an improved brake lever and reversing switch. The trolley arm through which the current is conveyed to the motor is of the double-elbow pattern, which accommodates itself automatically to the varying heights of the conductor and permits the operation of the car in either direction. On each side of the locomotive is placed an incandescent lamp, which serves the double purpose of signal and headlight. A 220-volt generator supplies the necessary current. The Thomson Van-Depoele Electric Mining Company, which designed this locomotive, has also in process of construction several new types suited to the requirements of different mines, hard and soft coal, iron and other metals, and for high and low entries and for gauges varying from 18 inches to the standard.

Electrical Exhibition at St. Petersburg.

MM. J. Pierson Fils, of 2 Rue de Canteleu, Lille, and 13 Wladiminsky prospect, St. Petersburg, have been appointed representatives of the Société Imperiale Polytechnique Russe in connection with the forthcoming Electrical Exhibition at St. Petersburg, organized by that body. The exhibition will be held in the centre of the capital, and will be opened about the middle of December next, closing March 15, 1892. For the first time in the history of Russia foreign firms have been granted the imperial permission to exhibit; and applications for space have, it is stated, already been received from Ganz & Co., Siemens & Halske, MM. Richard Frères, the Société Générale des Téléphones, the Compagnie Continentale Edison, etc., etc. The principal object of the exhibition is said to be to enable the Russian government to choose the best system, with a view to the inauguration of comprehensive electric lighting schemes in the principal towns of Russia. The charge for floor space is at the rate of 36 francs per square metre, 18 francs per square metre being asked for wall space. Foreign exhibits will be allowed to enter Russia duty free on the condition that they recross the frontier within a month of the close of the exhibition. All objects sold at the exhibition will have to pay the usual duty. The railway companies have granted a reduction of 50 per cent. on their usual transportation charges in the case of all goods intended for the exhibition.

An Electric Car Truck.

The illustration on this page shows a car truck for electric cars, which has many features in its construction that are advantageous from a mechanical standpoint. It is



THE FULTON FOUNDRY COMPANY'S NEW RAILWAY TRUCK.

constructed in such a manner that the wheels are always in line and run true, preventing, on account of the truck being rigid, the uneven wearing of the wheels. The main sills and cross sills are made of wood, which prevents bolts working loose and rattling. A new and improved form of brake is used, which is set on the main sills, so constructed that a direct pull is made on each brake shoe, giving the same pressure on each wheel, and when the brake is set its position is always the same relative to the car axles, so that no effect in pulling down or lifting the car body is noticeable.

If it becomes necessary to remove the wheels, the car can be jacked up and raised with the sub-sill left stationary to the body by removing four bolts on the side of the journal boxes and four others on the side of one of the main sills, and taking the lids off the oil boxes and removing the brass keys, when the whole side of the truck can be pulled off with springs and boxes attached. The above are a few of the important claims made in regard to this truck, many of which, it is stated, after constant service for months, have given the best of satisfaction and have fulfilled the guarantee made by the manufacturers, the Fulton Foundry Company, of Cleveland, O.

An Underground System for Washington.

The Electrical Commission appointed by President Harrison under an act passed at the last Congress, to investigate the question of an underground system for all electric light wires in the District of Columbia, has submitted its report. The report is the result of nearly a year's work, and is made up of many advanced propositions favoring the complete municipal ownership of all electric, gas and water franchises and giving a thorough discussion of overhead wires and underground systems. The first step taken by the commission was to learn the sentiment of local electrical corporations as to the feasibility and practicability of placing their wires underground. All of the companies but one agreed that the underground system was practical. The only exception was the Western Union Telegraph Company, which argued that the effect of underground wires was a retardation of the electric current to such an extent that it would require a large increase in the number of wires in the service. This, in turn, the company claimed, would necessitate a cutting-off of many of the local offices in the city, and an increase in the rates to compensate them for the increased cost.

To offset the points raised by the Western Union, the report incorporates a communication received from the chief electrician of the British post office department, in which he states that there are 25,000 underground wires in London, passing through the city for many miles, and no retarding effect is noticeable.

The commission having decided that the wires should go underground, next investigated the tax question, in order to determine whether any company would be entitled to consideration on account of extra expense involved in the use of the conduit system. It was found that during the year 1890 the aggregate amount of taxes paid in the District by all telegraph, telephone and electric lighting companies doing business in the District was only $1,052.

In view of this fact the commission did not hesitate in urging the absolute placing of all wires underground at once, and that the government ought to pass a law for the purpose, which should be rigidly enforced. The commission urges that the District government obtain the ownership of

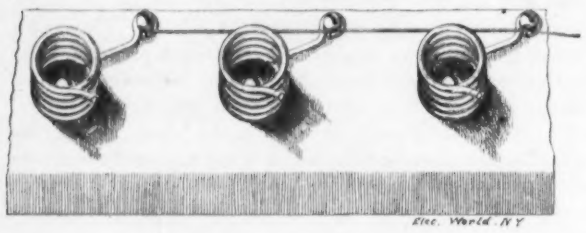
subways already constructed, and a plan is submitted for extending the system throughout the whole city. It provides for 56 miles of conduit and 315 miles of ducts, for the construction of which an appropriation of $500,000 is asked, with the recommendation that the ducts be rented to the companies at the rate of seven cents a foot per annum, or $370 per mile. In event of the plan for municipal ownership not being adopted it is urged that the companies laying conduits reserve free of cost to the District one duct for municipal use. Touching upon the best method of placing wires underground the report is against constructing a large tunnel in the centre of the street, but proposes instead a tunnel under the pavement on each side of the street, which could be built at a cost much less than the former.

Other recommendations are urged in regard to trolley wires, etc., and the report concludes with a recommendation that an electrical bureau be established in connection with the District government upon the plan now adopted in Philadelphia and Chicago.

The report, which was unanimous, was signed by Andrew C. Rosewater, of Omaha, as president; Lieutenant Schenck, of the Engineer Corps, secretary, and Professor Rowland, of the Johns Hopkins University.

The K A. P. Lamp Socket.

The accompanying illustration shows a quickly manufactured lamp socket which is the joint invention of Mr. Wm. D. Kurz and Mr. H. Amundson, of La Crosse, Wis. Mr. Kurz is superintendent and electrician of the Edison Light and Power Company of that place, to which fact is probably due the practical nature of the lamp socket here illustrated and described. It will be seen from the illustration that the socket is nothing more than a coil of brass wire mounted on a wooden base, one end of it being fastened under an ordinary screw: in the centre of this coil another



The K. A. P. Lamp Socket.

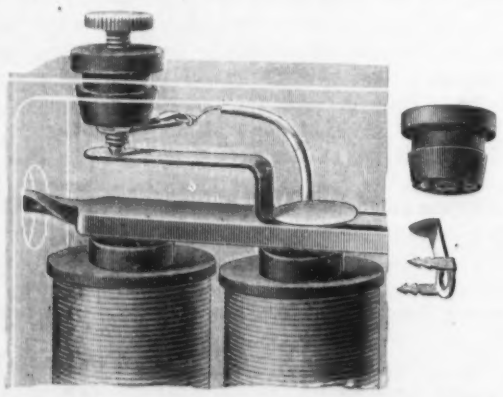
screw is set into the board, its end projecting on the opposite side, and this screw forms the other terminal of the lamp.

It will be seen that an Edison lamp may be screwed into the socket in the ordinary manner, and that in wiring it is only necessary to attach one of the lead wires to the projecting end of the screw on the back of the base and attach the other lead wire under the second screw on the front of the board base.

This socket is especially adapted for use in connection with outside illumination or temporary work of any kind, but is also suitable for use on inside work in many places, as the insulation can be quickly made. It is claimed that the wiring is so simple and so easily done that one man can readily wire 500 lamps in a day.

Combination Adjusting Screws.

Looking at the ordinary electric bell, now so universally used, one would hardly think there is room for improvement. Perhaps not so far as the user is concerned; but the manufacturer is ever on the alert for methods that will tend to better the bell without adding to its cost. An exceedingly clever and valuable improvement in bell manufacture has recently been patented by Richard Varley, Jr., of Passaic, N. J., and the apparatus has been placed upon the



Figs. 1 to 3.—Combination Adjusting Screws.

market by J. Jones & Son, 602 West Twenty-second street, New York City.

This device is called "A new method of assembling bells." It consists of but three parts, which take the place of the somewhat complex method now in vogue for the adjusting attachment. These parts are the rubber stopple, Fig. 2, which affords an insulator for the adjusting screw, and serves as a lock nut by compression of the rubber; the adjusting screw itself and a connecting clamp, Fig. 3. The purpose of this clamp is to connect the wire from the coils to the adjusting screw, it being held in position by the two prongs that fit into the small holes shown in the rubber stopple.

Fig. 1 shows the device complete attached to an iron box bell. In skeleton bells a lug is cast on the frame in place of the regular binding post now in use. Through this lug is drilled a hole which admits the rubber stopple.

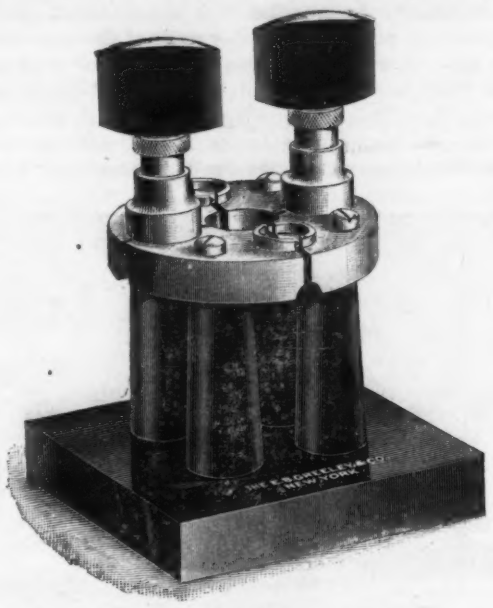


Fig. 1.—Double Plug Key on Pillars.

Aside from cheapening the materials necessary to make a bell, it greatly economizes the labor necessary for assembling the parts. It also adds to the bell's efficiency to the extent of preventing it getting out of adjustment by loosening of the screw, as the latter cannot turn in the soft rubber bed. In places where there is considerable jarring, such as in cars, factories, etc., the question of loose screws is an important one to be considered.

New Standard Measurement Apparatus.

The accompanying illustrations show a number of these instruments, the chief aim in the construction of which

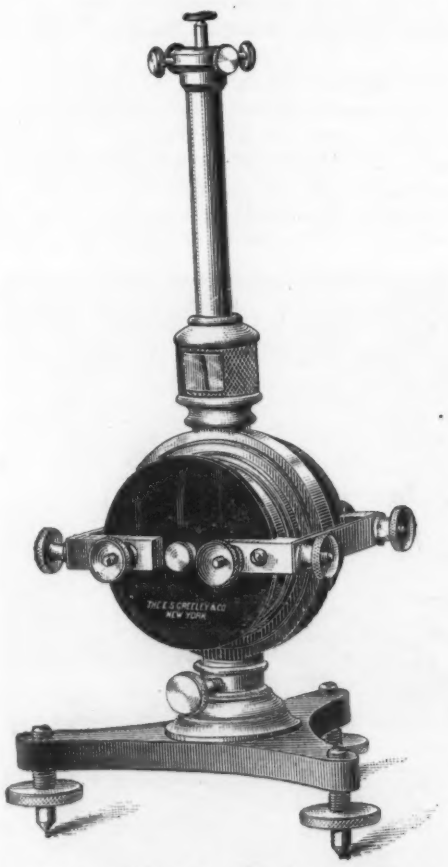


Fig. 2.—Ballistic Galvanometer.

has been to render them as light and portable as possible without endangering the essential features, accuracy and accessibility. Fig. 3 shows a megohm box having eight readings, four of which are, respectively, 100,000, 200,000, 300,000 and 400,000 ohms.

Fig. 4 shows a four-coil Thomson reflecting galvanometer of the Rowland type, placed on the market as a companion to the two-coil instrument of this variety.

Fig. 2 shows a cut of the ballistic galvanometer which, although built to a certain extent on conventional lines, embodies several novel features. The casing for the mirror is provided with a hood which can be turned so that the reflection from the mirror may be observed from either side. The coils, two in number, are usually connected together in multiple, but may be used independently by removing both of the coupling strips between the binding post blocks. The coils may also be connected together in series by removing but one coupling strip and giving the front coil a half turn. This galvanometer is equipped with a bell shaped magnet as designed by Siemens & Halske, is highly insulated, and is of superior construction and finish.

Fig. 1 shows a plug key mounted on insulated pillars. The plugs are provided with caps which prevent the pillar from spreading when the plugs are inserted, and secure firm contact.

These instruments are on exhibition at the salesrooms of The E. S. Greeley & Co., Nos. 5 and 7 Dey street, New York.

They were designed at the Greeley Electrical Laboratory by Mr. Charles P. Frey, electrician for the company, which has recently been engaged in conducting a series of elaborate and expensive experiments at its laboratory in order to determine what materials can be used to the best advantage in constructing commercial condensers for telegraphic and other purposes, with the object in view of eventually adding instruments of this type to its regular line of standard condensers. One of the necessary preliminary steps was to provide an improved ballistic galvanometer and some highly insulated plug switches. Models of these were designed by Mr. Frey, and shown to interested parties at the Montreal Exhibition. In response to a general request the Greeley company has decided to regularly manufacture these instruments in the future and place them on the market.

Electrical Progress in America Compared with That in Europe.*

BY CHARLES K. ADAMS.

No branch of Cornell University during the past year has manifested a more healthful activity than that of physics.

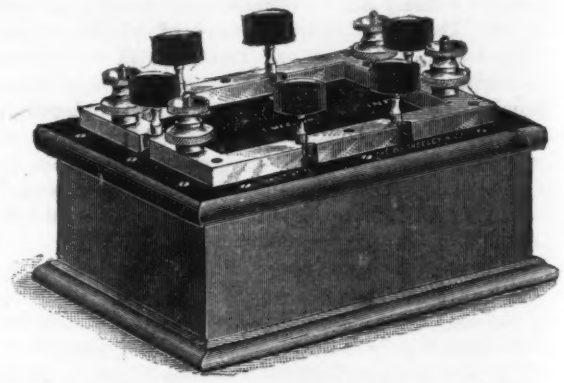


Fig. 3.—Standard Megohm Resistance Box.

The laboratory has had during the past year an unusual number of students pursuing advanced courses of study.

The unwonted importance which electricity has recently assumed in so many ways has drawn into special studies of the subject a large number of our ablest and most scholarly men. Colleges and universities are everywhere coming to realize that large expenditures for equipment in electrical physics are indispensable to success in the prosecution of these subjects. During the past year much more has been done in this direction than ever before. We have been in the habit of believing that in the practical application of electricity to industrial purposes America is far in advance of European nations. In the past this belief would seem to have been justified. But it is easy to see that nothing but a most careful attention to scientific as well as

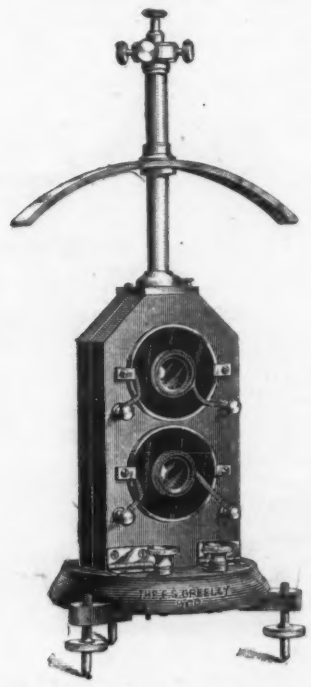


Fig. 4.—Four-Coil Galvanometer.

practical studies is to prevent the sceptre of supremacy from going to continental Europe. The electrical congress and exhibition held at Frankfort during the past summer must have been a surprise to every American who carried to it the supposition that in electricity America had nothing to learn from Europe. Indeed, the money that has recently been expended on the other side of the Atlantic for laboratories and equipment exceeds by many times what has

* Extract from the annual report of President Adams, of Cornell University.

been expended for the same purposes in the United States. One of the most striking and significant incidents in recent educational history is the fact that the little republic of Switzerland, with a population scarcely more than half as numerous as that of the State of New York, just after completing for its Polytechnicum at Zurich a chemical laboratory at a cost of half a million of dollars, has erected and equipped a physical laboratory, at a cost of three-quarters of a million. A visit to this laboratory in the course of the past summer revealed the fact that of the six professors and fourteen subordinate teachers, a majority are occupied with investigation and instruction in the various forms of electrical physics. This is but an illustration of the spirit and demand of the time.

Report of Mr. Hornsby as the European Commissioner of the Electrical Department of the World's Fair.

It will be remembered that Mr. Hornsby was sent to Europe about two months ago to obtain such information as he considered would be of value in the conduct of the electrical department of the World's Fair. A very thorough and careful investigation was made during the brief time at his disposal, and an exhaustive report on the administration of the Frankfort Electrical Exhibition and on the attitude of European electrical firms toward the coming exhibit at Chicago has just been made by Mr. Hornsby. While this report is intended primarily for the information and guidance of those who are in charge of similar work in Chicago, it contains much that will prove of interest and value to the intending exhibitor in this country and in Europe. A summary of that part which deals with the Exhibition and with the attitude of Europeans toward the proposed International Electrical Congress is here given :

The Service Plant.—Beginning at the boiler house, power and light were supplied after the following schemes : manufacturers of boilers wishing to place their machinery in competition were charged for the space it occupied under the regular schedule rates, installed the machinery, laid the foundation, etc., at their own expense. The exposition company furnished the fuel employed, but exhibitors maintained and operated their own machinery. The wiring used for the service of the exposition was obtained by rental, the exposition paying for the three months' use thereof 5 per cent. of the delivery price, the owner to reclaim it at the close of the exposition. The boiler house being adjacent to the main machinery hall, in which were the engines and electric generators, expense for connecting was borne jointly by the boiler and engine exhibitors. Exhibitors of engines were charged for the space which their engines occupied in the main machinery hall; each exhibitor installed his engines at his own expense, and paid to the exposition company an agreed amount for the steam necessary to operate the engines. Belting and the incidental apparatus for operating the generators from the engines were paid for by the exhibitors of dynamos, and these in their turn were charged for the space occupied by their generators and their electric apparatus, and the exposition company derived an additional revenue by charging the dynamo exhibitors for the power from the engines which was necessary for the operation of their machinery. The exposition company did the work of wiring necessary for the various department buildings, and charged against each exhibitor in these buildings an amount necessary to cover the cost of the light furnished to each.

By this system of able financiering the exposition company, sharing only in the expense to the extent of the wiring and the fuel, obtained revenue first from the steam which came from the boilers ; second, the power from the engines which were operated from this paid for steam, and third, for light furnished to individual exhibitors.

Lamps, incandescent and arc, were furnished free of cost to the exposition company in all the buildings and about the grounds by those exhibitors making displays of this class of apparatus.

Of course those exhibitors operating dynamos to supply current had the privilege of lighting space in which other of their own apparatus was on exhibition.

While the financial engineering, incident to this part of the work, reflects great credit on the management of the exposition, a repetition of the system would hardly be possible either in Frankfort or elsewhere. There seemed to have been a misunderstanding between exhibitors and the corporation as to the expenses incident to exhibition until exhibitors had progressed so far in their arrangements that it became impossible for them to decline exhibiting, therefore items of expense were borne which would not be tolerated on a second occasion.

Installation of Exhibits.—As has been before stated in this report, exhibits were divided into sections according to their affinity, and were placed in ten or more buildings. The large firms making general exhibits, therefore, were compelled to prepare, install, maintain and pay space and lighting charges at several points. In two instances at least, corporations operated and maintained 12 exhibits each, in separate buildings or out of doors, remote from the other locations of exhibits of the same firms. However much they might have desired to do so, the management of the exposition, carrying out its policy of sectionalizing exhibits according to their relationship to each other, would have found it impossible to save exhibitors the expense incident to the maintenance of these separate exhibits. Some of these in attendance upon the exposition, and at least a few of the directors of the corporation, maintained the position that the existence of several exhibits of one firm at different points in the grounds or buildings was an advantageous condition to exhibitors, because the tendency on the part of visitors would be to magnify the exhibitor's importance on account of his presence at so many points. The exhibitors, on the other hand, contended that the added expense incident to this separation of exhibits was not justified by the impression made on the minds of visitors, and contended further that the installation and maintenance of exhibits at so many points was too expensive to allow of that amount of decoration and the preparation of those features necessary to attract visitors. At least exhibitors were unanimous in the contention that the system was not one calculated to serve their best interests, and I would respectfully present this feature of my observation to the consideration of the management of the World's Columbian Exposition.

Ornamentation.—No stringent rules were laid against exhibitors for the installation of exhibits, and almost absolute freedom was allowed in their arrangement. The result was a most harmonious preparation of individual exhibits in the main buildings of the exposition, but a lack of symmetry and harmony in the effect of the whole. Elaborate ornamentation and spectacular arrangement of exhibits are features developed by the European exhibitor to a point unknown in this country. European electricians and European electrical manufacturing companies are far in advance of those in the United States in artistic lighting and in the electric installation of dwellings, hotels and theatres. The designers of electroliers and metal ornamental work spend much energy and great genius in these directions, and the result in an installation of exhibits such as that at Frankfort can hardly be exaggerated in description. Where usually there are iron railings with inexpensive and inconsiderable ornamentation, the exhibition spaces at Frankfort were enclosed by beautiful metal wreaths varitinted and exquisitely wrought, with here and there flowers of almost perfect design, enclosing within their petals tiny incandescent lamps, the globes tinted to reflect the shades of the flower intended to be presented. Wreaths in bronze, nickel and aluminium were twined around metal trunks of trees as the corner-posts of exhibits, and arches and canopies in vines of the same description separated parts of exhibits, as it were, by drapery, and secured for the exhibitor most beautiful effects.

As has been said before, there were concrete floorings wherever it was intended to operate machinery, and in these exhibitors having lighter machinery to exhibit prepared their space by erecting platforms suitable for the purpose, and though there were rules set specifically for the direction of exhibitors in the matter of the dimensions of these platforms, there was a general harmony created by a unanimous disposition on the part of the exhibitors to act co-ordinately with each other and with the management of the exposition. A few exceptions to this rule made possible an unharmonious effect that carried with it a strong lesson for the future.

In the case of heavy machinery, where preparations were necessary for the planting of driving wheels, etc., these preparations were made by going below the grade to a sufficient depth to allow of molded trenches in the concrete of proper dimensions.

European Exhibitors.—Taking advantage of the presence in Frankfort of the heads of representatives of more than 500 European electrical firms, I discussed with these, except in a few instances, the work contemplated for this department of the World's Columbian Exposition, and had expressions from them with regard to their participation. I would say, at this point, that there are only a few, possibly a dozen, electrical firms in Europe which do a general manufacturing business. The vast majority of electrical firms are engaged in manufacturing electrical specialties. In cases of the firms doing a general business I found objections on the parts of managers to exhibit at Chicago, on the score of the reputed superiority of American electrical machinery and the alleged inability of Europeans to compete along those lines. There are a few firms, however, so powerful in their own countries and so thorough in their methods that they feel themselves competent to compete for business in any field. These few firms, to the number of possibly three in Germany, two in Austria, one in Switzerland, two in Belgium, four in France and four in England, will participate in the World's Columbian Exposition in general competition and will make general exhibits. Exclusive of the above mentioned companies nearly all the electrical firms of Europe are engaged in specialty work.

These specialties they have developed to such a perfect state, that in spite of all extraneous hindrances they are able to do business not only in this country but throughout the world.

Barring unforeseen interferences, I have the satisfaction to state that a large number of electrical concerns in Europe will participate in the exhibition of this department of the World's Columbian Exposition.

For obvious reasons I shall not digress to the extent of discussing the intention of individual firms in respect of their participation at the World's Columbian Exposition, and will only say that the smaller firms—manufacturers of electrical specialties—admit that should the larger firms exhibit at Chicago, they, with their specialties, will be under compulsion to do the same, and to the end of securing this general result I am able to state that the following general electrical manufacturing companies of Europe will make complete and interesting exhibits at the World's Columbian Exposition :

Germany.—Siemens & Halske, of Berlin ; Schuckert & Co., of Nuremberg; W. Lahmeyer & Co., of Frankfort; O. L. Kummer & Co., of Dresden; "Helios" Company, of Cologne; Maschinenbau-Actien-Gesellschaft, of Nuremberg; Algemeine Electricitäts Gesellschaft, of Berlin.

England.—Siemens Bros., of London; Crompton Electrical Manufacturing Company, of London; Mather & Platt, of Manchester; Woodhouse & Rawson, of London, and conditionally a few others.

Switzerland.—Oerlikon Manufacturing Company, of Zurich; Alioth & Co., of Basle.

Belgium.—Société l'Electrique, of Brussels; Société Le Phenix, of Ghent.

Austria.—Ganz & Co., of Buda-Pesth.

France.—Victor Popp & Co., of Paris; Sautter, Harle & Co., of Paris; Carpentier & Co., of Paris; Breguet & Co., of Paris.

In order to discuss the business upon which I was ordered to Europe I visited in addition to Frankfort the cities of Nuremburg, Cologne and Berlin, in Germany; Paris and London. And besides a large number of questions which I was able to answer to the electrical people whom I saw, questions were asked me as follows, some of which being matters of corporation policy I declined to answer at the time:

"Will European firms be given an opportunity to participate in the electrical service of the exposition—this service meaning the lighting and power station work, electric water craft, intermural railway, installation of lighting system for theatre, lighting of the harbor by search lights and reflectors, etc.?"

"Will the Alien Labor law of the United States admit the employés of European exhibitors who are necessary to their installation, and the maintenance of exhibits?"

"Will there be a ruling at the hands of the United States government which will guarantee the integrity of foreign patents?"

"Will the exposition corporation undertake to secure an established freight rate on steamship lines for foreign exhibits in addition to a distinct railway rate?"

"Will European exhibitors who desire to participate in central station work be allowed to choose engine and boiler machinery, and will the machinery so chosen be arranged for by the exposition company—that is, will the exposition company undertake to secure the presence of such engine and boiler machinery by paying freight charges for the same in consideration of its free use during the exposition?"

"Will arrangements be made by the exposition company for the care, board, etc., of the employés of exhibitors, at a fixed rate, on the exposition grounds or in the vicinity, or must exhibitors make individual arrangements in this behalf?"

I was informed by at least two exhibitors that machinery weighing at least 45,000 pounds to the single piece would be a part of their exhibit, and the question was asked whether this machinery could be moved; the answer which I gave, viz., that arrangements would be made for moving pieces of 30,000 pounds, was met by the supplementary question, "How can heavier machinery be moved by exhibitors, and what will the same cost?"

I am anxious to be able to answer all these questions to these people to the end that they may prepare at once along the lines to be established for the perfection of their exhibits.

I beg leave to report briefly that in Paris I found a peculiarly unfortunate condition. There is a commission for France, made up of some of the best men in the republic, but the appointments to the commission were understood to be honorary, and no work has as yet been done. I learned from the Hon. Whitelaw Reid, American Minister, that upon the opening of the Chamber of Deputies this winter a bill will be introduced by the Premier for an appropriation with which to carry on World's Fair work, and that after the passage of this bill a working commission will be appointed, which in turn will appoint sub-commissions for the various departments. In the meantime, however, much unreliable information is being circulated, and the French people, especially the business men and manufacturers, are eager for reliable data. Failing to obtain this information, they are disposed to a lethargic attitude.

Advice was freely given me by Frenchmen enthusiastic in behalf of the exposition that a commissioner from the exposition ought to be constantly present in Paris, at least until a government commission is placed in charge of the work, to the end that those manufacturers who contemplate special preparations—and there are many such—need not postpone them to a dangerously late period.

As a part of my work in Europe, under instructions from the chief of the Department of Electricity, I visited several of the scientists of England and the Continent in behalf of an international electrical congress, for the success of which the chief of the Department of Electricity has been working since his appointment, and I am prepared to state that the success of the congress is assured; providing, of course, it is prepared and carried out in a manner satisfactory to the scientific men who will create its dignity and make its chief value. Among those whom I conferred with regarding this congress were Prof. Galileo Ferraris, of Italy; Prof. Siemens, of Berlin; Prof. W. E. Ayrton, of City and Guilde College, London; W. H. Preece, electrician-in-chief Telegraph Department of the British government; M. Hospitalier, of Paris, and M. Abdank-Abokanowitz, of Paris.

The consensus of opinion expressed by less distinguished men and others of eminence I may be excused for setting forth in the abstract as follows :

Hitherto, electrical congresses have not been successes, and essentially for the reason that the methods of their organization were not calculated to give them that dignity necessary to the accomplishment of effective work. In electricity there are practically no international electrical units such as are present in other sciences, and standards of measurement are not of that arbitrary character which would have grown out of official, authorized action in their establishment.

In arranging for such a congress as these men deem it necessary to have, they think the United States government ought to father the invitations and that it ought to be held under government auspices ; that invitations ought to be issued to individual scientific men of the world by the U. S. government, through the governments to which the individuals belong. This course of action, the gentlemen say, will insure an official character to the proceedings of the scientific congress, and will virtually pledge the various governments to a recognition and adoption of the standards created. If such a congress is to be held at all, it can only be a success along these lines, for past experience has determined the men, without whose aid such an affair would fall flat, to decline participation in any congress which has for its end less than the work outlined above—to the conclusion that the World's Columbian Exposition shall mark a distinct epoch, and the greatest one in the history of electricity. Further than this, it is admitted that while Americans have done at least their part for humanity in the science, there are no recognized units credited to Americans, and there is not a single mark made by an American in the nomenclature of the science. It is intended to alter this in case such a congress shall be held.

To carry out such a work as these scientific people picture to themselves, they would have established a purely scientific committee, embodying a member from each of the important governments, at least those which have contributed materially to the progress of electrical science, the duty of which committee should be to prepare a programme, including a settlement of the issues to be discussed and the individuals to take part in this discussion, to attend to the preparation of scientific work, etc.—in fact to prepare for the congress in all directions appertaining to science. Another working committee could also be appointed for the preparations other than scientific, to include gentlemen interested in the commercial success of electricity, and this committee could also convene, if it were deemed advisable, a congress of electrical engineers, which would indulge in discussions of commercial value of the appliances of electricity.

One other point was made by European scientists, namely, that such a scientific congress should be convened in August or September, as those months constituted the vacation of European professors; and nearly all the desirable electrical scientists of Europe are teachers in the educational institutions. They would probably not be able to attend during any other season.

In conclusion, I beg leave to report that Europeans fully appreciate the magnitude and completeness contemplated for the World's Columbian Exposition, and that they have arrived at that point in their enthusiasm where their chief topic of discussion in connection with it is that of the sufficiency of the means of transatlantic transportation for passengers and freight.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

The Closing Quotations of electric stocks on Saturday, Nov. 7, 1891, in New York and Boston were:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co.	100	86,200,000	82⅛	82⅜
American Telegraph & Cable	100	14,000,000	....	80
Central and South American	100	5,000,000	....	....
Mexican	100	2,000,000	....	....
Commercial Cable Co.	100	7,716,000	....	....
Postal Telegraph Cable	100	5,000,000	28	33
Edison General Electric	100	15,000,000	94	95
Consolidated Electric Light	100	2,500,000	20	30
Edison Illuminating Co.	100	4,500,000	79	80
" " " Brooklyn	100	750,000	76	80
" " " Boston	100	1,263,500	97½	102½
" " " Chicago	100	750,000	135	145
U. S. Illuminating Co.	100	1,250,000	30	35
North American Phonograph Co.	...	.....	2	4
New York Phonograph Co.	100	6,200,000	2¼	4
Edison Elec. Light Co. (of Europe) stock.	100	2,000,000	2½	5
" " " bonds	...	30,000	65	75
" Ore Milling Co.	100	2,000,000	17½	22½
" Toy Phonograph Mfg. Co.	10	1,000,000	½	1
U. S. Electric Light Co.	100	1,500,000	....	20
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co.	...	500,000	....	60
East River Electric Light Co.	100	1,000,000	....	60
Thomson-Houston Electric Co.	25	6,000,000	45	46
" " preferred.	25	4,000,000	24½	25
" International Electric Co.	100	1,000,000	....	200
Thomson Electric Welding Co.	100	1,000,000	....	....
" European Electric Welding Co	100	1,500,000	....	60
Westinghouse Electric Co.	50	7,000,000	13¼	14
Fort Wayne Electric Co.	25	4,000,000	12½	13

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Chicago	$212@ $220	Cumberland	$60@ $62
Central Union	50@ 51	Wisconsin	118@ 120
Michigan	82@ 83	Bell of Missouri	175@ 180
Great Southern	30@ 32	Iowa Union	20@ 22
Colorado	34@ 36	Missouri and Kansas	54@ 56
Rocky Mountain Bell.	40@ 43		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$97@ $99	Chicago Edison Co.	$145@$150

NEW INCORPORATIONS.

The Marion Manufacturing Company, of Chicago, Ill., with a capital stock of $20,000, has been formed to manufacture electrical and mechanical devices. The incorporators are Sidney N. Johnson, John H. Brown and Frank H. Fenno.

The Suburban Light, Heat and Power Company, of Chicago, Ill., with a capital stock of $50,000, has been organized to furnish light, heat and power for all purposes. Louis W. Johnson, Henry G. Joslin and Ernest C. Barrows are the promoters.

The Taylor Electric Light, Gas and Power Company, of Taylor, Tex., has been formed with a capital stock of $40,000, to manufacture and supply gas, light and heat to the city of Taylor. J. E. Tucker, E. Mendel and F. L. Welch-Taylor are the organizers.

The Northern Car Company, of Minneapolis, Minn., with a capital stock of $250,000, has been formed to manufacture street and railway cars, electric motors, etc. C. P. Jones, D. M. Gilmore, W. E. Steele and S. S. Thorp, all of Minneapolis, are the incorporators.

The United States Burglar and Alarm Company, of Galesburg, Ill., with a capital stock of $50,000, has been organized to manufacture, sell and erect burglar alarms and electrical specialties. Octavius J. Colton, Abraham Anderson and Noah M. Powell are the incorporators.

The John A. Crisp Electric Belt Company, of Jefferson, O., has been formed with a capital stock of $25,000, to manufacture and sell the John A. Crisp body battery and appliances. John A. Crisp, E. L. Hills, W. M. Kellogg, J. P. Caldwell and A. L. Arner, M. D., are the promoters.

The Walton Electric Light Company, of Walton, N. Y., with a capital stock of $20,000, has been incorporated for the purpose of manufacturing and using electricity for light, heat and power. John Babcock, Charles B. Bassett and Sam. H. Francher, of Walton, are the promoters.

The Marshall Electric Light Company, of Marshalltown, Ia., has been organized with a capital stock of $60,000 to build, equip and maintain an electric light plant at Marshalltown, Ia., J. M. Parker, B. E. Surrey, T. L. Seevers and George Martin, all of Marshalltown, are the promotors.

The Clay and Forrest Park Railway Company, of St. Louis, Mo., with a capital stock of $50,000, has been formed to build and operate by electricity or cable a passenger railway. T. K. Skinner, J. L. Boland, B. F. Thomas, V. B. S. Buchanan and R. E. Carroll are the incorporators.

The Decker Electrical and Novelty Manufacturing Company, of Detroit, Mich., with a capital stock of $20,000, has been incorporated to manufacture and sell electrical and all other kinds of machinery. Chas. H. Decker, Chas. W. Harrah and L. M. Thayer, all of Detroit, are the promoters.

The Adjustable Telephone Manufacturing Company, of Cincinnati, O., with a capital stock of $20,000, has been organized to manufacture, sell and set up telephonic instruments, electrical instruments, etc. Jas. P. Hall, M. A. McGuire, August W. Bruck, J. Wm. Johnson and H. M. Caldwell are the incorporators.

The Victoria Investment Company, Limited, with a capital stock of $100,000, composed of Thomas Badenack, Geo. E. Jacques, Jr.; J. B. Clarkson, S. C. Stevenson, of Montreal, and James E. McDougall, of Chicago, has applied to the Lieutenant-Governor in Council of Canada, for letters patent incorporating them under the above title. The principal place of business of the proposed company will be in Montreal. Besides the ordinary transactions in real estate, the applicants ask to be empowered to erect electric light plants, water service and horse or electric cars on and for the service of the property owned by them.

AFFAIRS OF THE COMPANIES.

Millbury, Mass.—The Millbury Electric Light Company has declared a dividend of 1½ per cent.

Taylorville, Ill.—The Taylorville Electric Company has increased its capital stock from $15,000 to $22,000.

Camden, Ark.—It is stated that the Camden Electric Light and Power Company is to increase its capital stock.

San Francisco, Cal.—The Geary Street Park and Ocean Railroad Company has declared a dividend of $1 per share.

The Shultz Belting Company, of St. Louis, has filed affidavit of increase of capital stock from $300,000 to $500,000.

The Edison Electric Illuminating Company, of New Orleans, La., has declared a quarterly dividend of two per cent.

The International Okonite Company, Limited, of New York, recently declared a semi-annual dividend of four per cent.

Quincy, Mass.—The Quincy & Boston Street Railway Company, at its annual meeting, elected the following officers: President, John R. Graham; secretary and treasurer, Fred H. Smith.

The Thomson European Electric Welding Company has declared a dividend of $25 per share, payable Nov. 18. This calls for $375,000, it is stated, and leaves some $75,000 to $80,000 in the treasury.

Fall River, Mass.—The Edison Electric Illuminating Company, at its recent annual meeting, re-elected its old board of directors. Henry K. Braley resigned as clerk, and A. F. Dow was elected in his place. A quarterly dividend of 2 per cent. was declared.

Connellsville, Pa.—The old Board of Directors of the Connellsville Electric Company, composed of John D. Frisbee, Charles Davidson, Dr. E. Phillips, J. S. McCaleb and J. M. Reid, re-elected at the recent stockholders' meeting, organized by electing J. S. McCaleb president and E. T. Norton secretary and treasurer.

The Baltimore City Passenger Railway Company's 5 per cent. gold 20-year bonds to amount of $2,000,000 were sold recently to Messrs. Alexander Brown & Son at a price reported unofficially as for par. There were six other bidders. The bonds are secured by trust mortgage to the Safe Deposit and Trust Company, of Baltimore, of all the property and franchises of the road, which is 46½ miles long. The original capital stock of the company is $1,000,000. The money will be used in cabling the line.

The Detroit Electrical Works, it is stated, expects to have the addition to its plant completed within 90 days. Three motors a day can then be turned out besides making an increase in the production of its other departments. It is now estimated that the company will next year be able to handle $2,000,000 of business. It has recently closed several large contracts, and negotiations are in progress for more. The dividend question has not as yet received any consideration and probably will not until January.

The directors of the Holyoke (Mass.) Street Railroad Company met recently to prepare the annual report of the company, which will be submitted to the railroad commissioners. The report will show that the permanent investments of the company amount to $172,545, distributed as follows: Paving, $16,136; track, $72,066; cars, $54,481; horses, $700; other equipment, $1,285; real estate, $27,876. The property accounts have increased in valuation during the year $100,000, while the depreciation has been $10,379, leaving the net addition for the year $90,421. The revenue for the year has been $41,036, and the operating expenses $34,072, with an interest account of $549. The company now has seven miles of track, 14 closed cars, 12 open cars and 5 horses and miscellaneous equipment. Applications for extensions have been received from the suburbs of Oakdale and Springdale.

The Fort Wayne Electric Company, of Fort Wayne, Ind., has declared a semi-annual dividend of 75c., payable Nov. 16, to stockholders of record Nov. 6. It is stated that the earnings of the company for the last six months have been double the amount necessary to pay the semi-annual dividend, and that stock previously held in the treasury to the amount of $1,000,000 has been disposed of at $12.50 per share. The company recently offered its stockholders the right to subscribe to 80,000 shares of Fort Wayne Trust securities, Series A, at $6.50 per share, in proportion of one share to every two shares of Fort Wayne stock held. It is stated that the company has transferred to the American Loan and Trust Company as trustee a little over $800,000 of mortgage bonds bearing five to six per cent. interest and about $700,000 of stocks of various companies acquired in the natural course of its business. It is expected that after first 90 days of the operation of the trust the trustee will be able to disburse quarterly dividends at the rate of 12 to 15 cents per share, from interest and dividends on the securities.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Nov. 9, 1891.

Mr. Paul G. Burton, electrical contractor of Albany, N. Y., called at the office of The Electrical World last week.

Mr. J. S. Bell, of the Ball Electric Light Company, Ninth avenue and Twenty-seventh street, reports a gratifying increase of business and a large number of orders ahead.

Mr. Albert E. Plowman, the genial representative of William H. Weston & Co., manufacturing electricians, Philadelphia, called at the office of The Electrical World last week.

Mr. Frank W. Gilbert, general manager of the New York office of the Tanite Company, 161 Washington street, states that business is active. With the energy which he displays in pushing his business, it could not be otherwise.

Mr. Elias E. Ries, of the Ries Electric Specialty Company, of Baltimore, Md., is in town and reports the business of his company very brisk. This company manufactures a regulating socket for incandescent lamps that has lately been placed upon the market.

Mr. F. Day Voorhees, general sales agent for the Norwich Insulated Wire Company, 58 Cedar street, states that the demand for paper insulated wire shows an increase, and that users of insulated wire are beginning to realize that paper insulation will not burn out.

Mr. John E. Beggs, of 74 Cortlandt street, states that within a short time he will bring out something entirely new for the transmission of power, for using the current of rivers having no waterfall, when the current runs from three to ten miles per hour, with a depth of from two to four feet. It will be a new water wheel, which will practically and effectually settle the question of utilizing the natural current of rivers, and will be especially advantageous in power transmission for mining districts.

Pierce & Thomas, engineers and contractors, of 42 Cortlandt street, have recently placed two 13 × 15 McIntosh & Seymour engines in the Presbyterian Hospital and one 9 × 9 and one 12½ × 12 in the Sherry building, Fifth avenue and Thirty-seventh streets, New York, also a 150-h. p. compound tandem R. R. engine for the Edison General Electric Company of Milwaukee. They have recently completed a power plant for the Columbus (Ohio) Consolidated Street Railway Company.

Stanley & Patterson is a new firm which has recently started out in the electrical supply business at 32 Frankfort street. The members of the firm are Mr. A. F. Stanley and Mr. Geo. L. Patterson, both gentlemen well and favorably known to the electrical trade. Mr. Stanley was formerly of the firm of Stanley & Hall, and Mr. Patterson has been traveling representative for the latter for the past four years. They will do a general electrical supply business, and will have always in stock a full line of electrical house furnishings. The new firm has no connection whatever with the affairs of Stanley & Hall, whose business matters are now being adjusted by a receiver, mention of which was made in The Electrical World Oct. 17.

N. H., 2D.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., Nov. 7, 1891.

The Newton Rubber Company is bringing out a number of new novelties in mechanical rubber goods for the electrical trade, of which the company makes a specialty.

H. N. Bates & Co. are now nearly settled in their new quarters, corner Congress and High streets, where they have some of the best appointed offices and salesrooms in the city.

The Norfolk & Suffolk Street Railway Company has been granted a franchise by the Hyde Park selectmen to build a street railway from Boston to the Dedham line through Hyde Park, on River street and Hyde Park avenue.

The Shipman Engine Company reports business as unusually good. The sale of engines for running small electric plants is increasing constantly, and their use has shown that they are peculiarly adapted for this purpose.

The Porter-Leavitt Motor Company, of Providence, is about to increase its facilities by the erection of a new factory. The call for small motors has been unprecedentedly large and beyond the most sanguine expectations of the company, and this step has become imperative.

The Cambridge City Authorities have refused to give permission to Harvard College to run wires across certain streets for the purpose of lighting the college buildings with their own plant. This is a sore disappointment to the college, as plans had been drawn and contracts made for the plant on the supposition that there would be no trouble in getting the right of way for the same. Thursday the contractors were notified that they were released from their contracts, and the matter is now at a standstill.

The Edison General Company for the New England District is fitting up some very extensive and beautiful rooms to show the various fixtures manufactured by the company. Mr. Fred. M. Kimball has been appointed manager of the supply department, which includes everything made or carried in stock. The company is very fortunate in securing the services of one so well qualified in every way to fill this responsible position as Mr. Kimball, who has had years of practical experience as a manufacturer and a manager and will use this experience to good advantage for the company he now represents.

The West End Street Railway Company will hold its annual meeting, it is stated, Nov. 12, for the transaction of general business and the election of two directors in the place of directors Potter and French. President Whitney will give his annual report, which, it is stated, will probably show above $100,000 surplus, although $200,000 more in dividends has been paid. In a recent circular calling attention to financial matters and the affairs of the West End Street Railway, Messrs. Devens, Lyman & Co., of Boston, stated the following: If we look forward and suppose that, at the end of 1895, the entire car system of Boston is using electricity as a motive power, which seems possible if not probable, and allow for a gross increase each year of 5 per cent., which has been the average increase for the last twenty years, then taking the 1890 gross earnings to start with, we can figure the gross earnings for 1895 and allowing 60 per cent. for operating expenses, although the best overhead systems, like the one between St. Paul and Minneapolis, are operated for less than 50 per cent., we can figure the possible net result for 1895—

Gross earnings for 1895, estimated as increasing 5 per cent. each year.	$7,377,011
Net earnings, 40 per cent.	2,950,804
All charges, including taxes, track construction, and preferred dividends.	1,273,028
Balance applicable to common stock dividends.	$1,677,776

Thus, even if it should be necessary to increase the common stock to the large sum of $16,000,000 to complete the electric system, still the company could pay 10 per cent. on its additional common stock. Although these figures are merely suggestions of the possibilities of the company, and many contingencies may arise to alter them, still the fact remains that the gross earnings have increased at the rate of 5 per cent. for the last 20 years, and there is no reason why they should not continue to increase at the same rate with the growth of the city, etc., and 60 per cent. is a very fair amount to allow for operating a well equipped electric road. We desire to make one more point. Some people have feared that the invention of a storage battery, or some other form of electric motive power, would do away with the overhead system, and necessitate an expensive change. Granted that this is a possible contingency, we would call attention to the fact that the overhead system only costs about $3,000 per mile, and therefore the total loss on 236 miles (West End mileage) of road would only be at the worst about $700,000. The power stations could probably be otherwise utilized, and would not necessarily be a loss.

C. A. B.

Messrs. Hart & Hegeman, of Hartford, Conn., report that business is good with them, and that they are selling a great many of their single and double pole switches.

The Crown Electric Manufacturing Company, of Bridgeport, Conn., has been incorporated, with a capital of $10,000. This company will manufacture sockets, switches, etc.

The New England Electrical Company has opened offices and stores at No. 7 P. O. Arcade, Bridgeport, Conn. Messrs. Perry and Griffing are the managers. The company will do a local supply and wiring business.

The Star Electric Company, of Bridgeport, Conn., has recently enlarged its store, and reports business as good. The company has recently installed a number of the new Chapman dynamos and motors, which have so far given very good satisfaction.

The National Electrical Manufacturing Company, of Milford, Conn., reports that its business on contract work is excellent. There is a large demand for microphone batteries. This company received a large order by cable from London last week.

The Steele & Johnson Manufacturing Company, of Waterbury, Conn., is running nights on brass goods for different electrical devices, and is at present behindhand on orders. A large quantity of model shade holders are being sold, which have been very favorably received by the trade.

The Bridgeport Electric Light Company is building an addition of a second story and is moving its offices up stairs. Heretofore its offices have been very crowded, and the above addition became a necessity. At the present time this company has in service 8,000 incandescent lights and 3,000 arc lights. The officials who are making such a success of this plant are J. M. Orford, manager; Chas. A. Paul, chief engineer; Geo. Preece, in charge of the incandescent department, and Frank Latimer, in charge of the arc department.

Eldred W. Clark, of Hartford, Conn., is still meeting with great success in the sale of his new improved tubing machine for the manufacture of rubber tubing for the covering of electrical and telephone wires. The machines are now made in three sizes, number 1 being small, number 2 medium and number 3 large; the largest covering a cable up to 3⅛ inches in diameter. The others are for ordinary wires, up to ½ or ¾. These machines are now in use by the New York Insulated Wire Company, Crescent Insulated Wire Company, the Edison General Company, both in Schenectady and Canada; Messrs. Morse & White, Boston, and a large number of electrical companies, and by many rubber manufacturers.

The Jewell Belting Company, of Hartford, Conn., shipped this week two 30-inch double belts to the Manufacturers' Electric Light Company, of Philadelphia, also several large orders to the Metropolitan Street Railway Company, of Macon, Ga., the Edison Illuminating Company, New York, and Milwaukee, Wis., and various other electric light and power plants. The facilities for turning out first-class belts in short order came directly under the writer's notice while at the factory some few days since, when, inside of 12 hours after receiving an order a belt 40 inches wide, three ply and 100 feet long was made and shipped. The belting made by this company is remarkable for its wearing qualities, and is being favorably received all over the United States and Canada.

L. H. H.

SOUTHERN NOTES.

WASHINGTON, D. C., Nov. 7, 1891.

The Electrocution Cases—The United States Supreme Court has advanced and assigned for argument the first Monday in December the cases of the two murderers to be executed in New York by means of electricity.

The Illumination of a New Building.—The magnificent nine story granite building, of the Washington Loan and Trust Co., at the corner of Ninth and F streets, is now illuminated by electricity every night. The electric light plant was completed a few days ago.

The Columbia Phonograph Company, of Washington, D. C., at a recent meeting of its directors, elected the following officers for the ensuing year: President, Edward E Easton; vice-president and treasurer, Wm. Herbert Smith; secretary, R. F. Cromelin; finance committee, Messrs. Benjamin Durfee, Chapin Brown and Charles H. Ridenour.

Appropriation for Electric Service.—The estimates completed a few days ago by the Commissioners of the District, for the amount of expenses for the year ending June 30, 1893, call for $33,020 for the telegraph and telephone service, including a new repair man, and $8,000 for new poles and special line repairs. The last named item of expense is urgently demanded, inasmuch as many of the telegraph and telephone poles of the city are in a dangerous condition and may any day cause serious accidents.

The Hanson Light and Power Company, of Washington, D. C., at its recent stockholders' meeting, elected the following officers and directors: President, Charles Childs; vice-president, F. Garlich; secretary, Frank Aldrich; treasurer, Frank Schwarz; general manager, Frank Aldrich; attorneys, George C. Hazelton, Wm. A. Ashley, of West Virginia; electrician, W. Hanson; directors, Charles Childs, George P. Bohrer, Albert Ordway, E. H. Neumeyer, F. Garlich, Frank Aldrich, Frank Schwarz, W. Lake, M. G. Copeland, W. Hanson, I. P. Childs.

A good deal of discussion has naturally been provoked among those interested in electrical corporations of this city, as well as among the officials of the District of Columbia, by the recommendations made by the board appointed to consider the location, arrangement and operation of electric wires in the District. An abstract of the report recently submitted to the President is given in this issue of THE ELECTRICAL WORLD. Mr. A. A. Thomas, president of the United States Electric Lighting Company, when asked his opinion regarding the report, said: "Having hastily glanced over the abstract of the report of the commission, I am, of course, not in a position to express any very positive opinion regarding the report. I can say, however, that the views of the commission in favor of the system of underground wires are right in line with the practical work which is now being done by our company in this city. We have now in this city some 35 miles of underground conduits, and ours was the first company in the country to make a full and complete test of the system, as we began to put our wires underground two years before Congress required it to be done. I also note with pleasure that the commission commended the kind of conduit which we adopted and which we have put down."

Commissioner Bossell, of the engineer department at the District building, has naturally the most interest in the report of the Electrical Commission and the recommendations made therein. Commissioner Rossell stated that he had not studied the report very deeply, having merely glanced over the document as printed. However, he was deeply interested in the matter. In the line of his former duties the question of underground wires had not entered, and he had been solely taken up with the overhead wires, but he could say, without reservation, that the quicker they were put under ground the better.

Captain Lusk, under whom the underground systems directly fall, thinks the engineering ideas and conclusions of the report are excellent. He fully approves of the idea that the wires should be put under ground and should be placed along the sides of the street and not in the middle. It was an excellent idea also, he thinks, to have the dangerous wires and traps painted red. He is in full accord with the engineering portion of the report.

Mr. S. M. Bryan, president of the telephone company, having just returned to the city from a brief business trip, when seen had not read the report of the commission. He said he had heard something about the conclusions reached, and he was glad to know that the commission indorsed the conduits which the telephone company was now putting down.

Commissioner Douglass, one of the civilian commissioners, had not studied the report and had very little to say in the matter. He approved of the general idea of putting wires under ground and especially favored making all corporations putting down conduits save one duct for the free use of the District service.

Commissioner Ross expressed his unfamiliarity with the report, but was in favor of reserving room in any conduits for the District use, and thought the wires should not only be put under ground, but that the District in some way should obtain revenue from them.

Superintendent Miles of the District fire alarm and telephone service, had not read the report and was unprepared to give his opinion.

Mr. Allen, Washington manager of the Postal Telegraph Company, said, speaking of the Electrical Commission's report: "Our wires are under ground now, and therefore we are not particularly interested. The only thing we want is that our subways shall be protected. We would have no trouble with our underground wires were it not for the fact that every now and then some one digging up the streets drives a pick through them. In other respects the system works very well, though it is very expensive. It is nonsense, however, talking about running electric roads by an underground system. As to the proposition to have subways owned by the government, on which a rental is charged for wires, that would probably be a good way out of the trouble if too high a rent were not charged."

A. E. O.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Nov. 7, 1891.

Mr. D. D. Crowley, of Duluth, was in Chicago this week purchasing supplies.

Mr. Frank Wunder, of Chicago, secured the contract for the electric lighting plant at Muncie, Ind., and will install the Western Electric system.

The Illinois Electric Material Company, of Chicago, sold this week more than 20 miles of new single woven canvas jacket insulated wire.

Mr. W. J. Pilley, manager of the Chicago office of the Eastern Electrical Supply Company, Boston, has returned to this city from a very successful western trip.

Mr. J. T. Hambey, of the Beacon Vacuum Pump and Electrical Company, of Boston, is calling on the trade in Chicago this week and introducing the Beacon lamp.

Mr. W. P. Sullivan, who has made many friends during his management of the Chicago Electric Club, has resigned that position to engage in more lucrative business.

Mr. Merwin J. Bulkley, formerly of Rochester, N. Y., has taken charge of the Western branch office of the *Electrical Review* and is leaving a very pleasant impression wherever he calls.

The Department of Electricity of the World's Columbian Exposition is making an effort to secure a complete collection of historical electrical apparatus, in order to show the progress of the science from early times.

Mr. Wm. W. Burnham, treasurer of the Electric Gas Lighting Company of Boston, is in Chicago this week calling on the various supply houses. Mr. Burnham has been very successful in securing large orders for the Samson battery, among others an order for 5,000, one for 3,000, and several for 500 cells.

The American Street Railway Association has applied for 50,000 square feet in the World's Fair Transportation building, and appointed a committee to help Chief Smith get a suitable exhibit, which will be collective. The committee comprises men interested in street railways from New York to San Francisco, and from Montreal to St. Louis. John B. Parsons is the Chicago member.

Mr. B. F. Jones has been appointed superintendent of the Riverside Park Railway Company, of Sioux City, Ia. When the Riverside road was converted from a steam to an electrical railway Mr. Jones installed the entire electrical equipment and built the overhead lines. That his work was well done is shown in the record made by the road on special occasions, when 225 people were carried on some of the trains, all of which were loaded for several hours at a time. The Westinghouse system is used.

The Electric Merchandise Company, of 11 Adams street, Chicago, is still engaged with the same rush of business that has occupied its attention during the summer, and begins to wonder if the customary cessation is really to be experienced this winter. Present indications are against it. For standard line material, station and car equipment, an ever increasing demand is reported, while repeated large orders for Pratt's Portable Conductor's Register and the Burton Electric Heater are being filled.

Electricity is to be the motive force in Jackson Park during the construction of the World's Fair buildings. The electric plant has been completed and steam engines must go. This is done in order to reduce the fire risk. The saw-mills, used in getting out building material, which have been run by steam, are now supplied by electric power, furnished, if desired, night and day. Electrical Engineer Sargeant is prepared with a 60-h. p. plant to supply electric motor service. In a few days 300 h. p. will be available.

The Electric Appliance Company, of Chicago, will open a large supply house at 242 Madison street, about the middle of November, and carry a complete line of general electrical supplies, and also certain electrical specialties which it has secured control of. The officers of the company are gentlemen of extended experience in all branches of the supply line and are well known to the electrical trade, the president, Mr. Willard W. Low, having been the traveling representative of a supply house and a carbon factory; Mr. Harry B. Gilbert, the vice-president, is well-known to the local trade, while Mr. Thomas I. Stacey, the secretary and treasurer, has had an extended practical experience in all the details of the supply business that should enable him to steer clear of breakers and make a success of the business from the beginning. It is to be hoped that profitable orders may flow in to them from the start.

An Automatic Telephone Exchange.—Mr. A B. Strowger, formerly of Kansas City, Mo., has an automatic telephone exchange on exhibition in room 301, the Rookery, Chicago. This device was referred to in THE ELECTRICAL WORLD'S patent record in the issue of March 21, 1891, and consists of a set of strap keys attached to a small rubber base which is placed on top of the battery box of each telephone, the necessary batteries and automatic "connector" that is located at the central station. On the exhibition telephone five keys are placed on the battery box with thousands, hundreds, tens and units marked thereon. A person desiring to connect with a number—say 1,457—pushes the thousand key once, the hundred key four times, the ten key five times and the one key seven times. The numbers of the telephones are so placed that the pressing of the keys connects them together and the aid of an operator is unnecessary, while an additional key releases the connection. The Strowger Automatic Telephone Exchange Company will push the introduction of this new device in all the smaller towns at first and believes it will meet with ready demand as the entire cost of installing is very small.

F. DE L.

KANSAS CITY, Mo., Nov. 6, 1891.

Mr. Thos. H. Clohesy has been appointed agent for Standard arc lights and dynamos.

Mr. Thos. L. Townsend, of Partrick, Carter & Co., Philadelphia, was in the city recently.

Chanute, Kan., will have a 650-incandescent and 30-arc dynamo of Thomson-Houston pattern.

Osborne & Co. have secured the contract for putting in a 400-light Eddy dynamo in the new Heist building.

The contract for wiring a large new office building here has been let to J. W. Osborne & Co. It will be about 800 lights.

H. M. Underwood, of Chicago, representing the Safety Insulated Wire and Cable Company of New York, dropped in on us last week.

Mr. J. W. Godfrey, general manager of the New York Insulated Wire Company, was in the city last week en route from New Orleans to San Francisco.

N. R. Ferguson, Treasurer Missouri and Kansas Telephone Company, has been elected to the directorate made vacant by E. E. Cook, of Davenport, Iowa.

Leavenworth, Kan., is complaining of poor electric light service. The Leavenworth Light and Heating Company has purchased a Slattery alternating incandescent machine at a cost of $9,000, and improved service is now promised.

The contract for an electric light plant at Salisbury, Mo., has been let to the Franklin Electric Company, of this city. It will have a capacity of 300 incandescents and 30 arcs. Construction will begin in a short time, and the plant will be ready for operation in about 60 days.

The Fort Wayne Electric Company will furnish the dynamos and other electrical apparatus for the Saulsbury, Mo., plant; the Russell Engine Company, of Massillon, O., the driving machinery; and the Franklin Electric Company will do the construction work. This firm will also do the complete insulation work on the Albany, Mo., plant.

H. D. E.

ENGLISH NOTES.

LONDON, Oct. 28, 1891.

Gordon Accumulator Car.—Messrs. J. E. H. Gordon & Co. have just completed an accumulator car for the Birmingham Central Tramway Company, in which there are four slow speed motors mounted direct on the axles. The car is a large one, to carry 80 passengers, and is mounted on two bogey carriages.

London County Council and Overhead Wires.—For the third year in succession the County Council is preparing a bill, giving it power to require that, in any thoroughfares, where there are subways, gas, water, electric lighting and other similar companies, they shall be obliged to lay their mains in these subways, paying the Council an annual rental.

Baron de Reuter, head of Reuter's Telegram Company, has received the sanction of Queen Victoria to assume in England the title of Baron, conferred upon him by the Duke of Saxe-Coburg. This privilege has been granted only five times during the reign of Queen Victoria, and is in special recognition of the services of Baron de Reuter in establishing a system of international intelligence.

City & South London Railway.—The continuous wet weather of the past month has had a favorable effect on the receipts of the City & South London Railway, the average weekly receipts being about £750, as against £650 a month or so ago. The beautiful simplicity of a uniform fare and no tickets which characterized this line at the time of its opening, and which has already been broken into, will probably shortly disappear altogether. The directors have now arranged to issue season tickets, and have decided to increase the maximum fare during the busy hours of the morning from 2d to 3d.

Experimental Verification of the Law Connecting Variations of Electromotive Force and Atmospheric Pressure.—In a recent note in *Comptes Rendus* M. Gilbault gives the results of some experiments made by him with a view of verifying Helmholtz's theorem with regard to the variation of the electromotive force of a battery under variations of pressure. The agreement between theory and experiment is something remarkable. For instance, the variation in ten-thousandths of a volt of the E. M. F. of a Daniell cell under a variation of pressure of 100 atmospheres should by Helmholtz's theory be + 5.17, and was found by M. Gilbault experimentally to be + 5.

Telegraphic Communication with the Continent.—On Saturday last the remaining vestiges of the now defunct Submarine Telegraph Company, which up to two and a half years ago owned practically all the cables connecting Great Britain with the continent of Europe, disappeared by the transference of the telegraph staff from the old premises in Throgmorton avenue to the Central telegraph office. Although the tariff reductions at the time of the transfer of these cables to the British government were not very great, the improvement in the telegraphic service between the chief towns of England and the commercial centres of the Continent has been most marked.

Answers to Correspondents.

Incandescent Lamp Induction.—I have an induction coil giving about a quarter inch spark without condenser. By connecting one terminal of the coil to the leads of an incandescent lamp and taking hold of the glass bulb with one hand and the other terminal of the coil with the other, the lamp will give a clear blue light, enough to enable a person to distinguish small print in the dark. There is a very distinct sensation of current passing through the body. How does the current get through the glass and vacuum of the bulb? Can you give an explanation of this? H. N.

The effect you have noticed is one well known to incandescent lamp makers, and is a pure case of induction. The discharge that lights up the lamp inside is inductive and due to the oscillations of current from the induction coil. A vacuum such as is found in incandescent lamps permits the passage of electricity fairly well, so that these inductive effects take place quite readily if the vacuum is not either too good or too poor. Air at ordinary pressures offers a very serious obstacle to the passage of electricity, but as the pressure is reduced up to a certain point, the electric discharge through it takes place more and more readily; finally, however, when the rarefaction is carried still further, the exhausted space becomes almost perfectly non-conducting, so that even a very powerful spark cannot pass through it. The sensation may be in part due to the actual sneaking of current along the usually somewhat dirty surface of the glass, and also to the condenser effect produced between the glass, the metallic cap of the lamp, and the hand; the two latter forming parts corresponding to the coatings of a Leyden jar. This condenser action also makes itself felt when the lamp is merely presented by the hand to one terminal of the coil.

News of the Week.

THE TELEGRAPH.

New Telegraph Lines.—The Western Union Telegraph Co. is engaged in erecting a direct line from Hagerstown, Md., to this city.

Norwood, N. C.—The Western Union Company is distributing poles along the line of the new Yadkin road, and will build a line to Norwood.

The Canadian Pacific Railway Telegraph Company, controlling the cable between Halifax, N. S., and Bermuda, reports an excellent business.

Roanoke, Va.—A direct wire between the Norfolk & Western Railroad offices in this city and the headquarters of the company in Philadelphia has been erected and is in working order.

The operating room of the Western Union Telegraph office, at Louisville, Ky., was damaged by lightning the morning of Nov. 8 to the extent of from $35,000 to $50,000. The entire outfit of instruments and batteries was lost, worth about $10,000.

Rome, Ga.—The Western Union Telegraph Company has made a reduction in rates in 500 offices in the States of Mississippi, North Carolina, Georgia, Kentucky, South Carolina, Alabama and Tennessee. The reduction is from 50 to 40 cents in some instances, and from 40 to 25 cents in others.

A Blind Telegrapher in a Connecticut town receives messages as rapidly and as accurately as any of his fellow operators. Few of those who work with him are aware that he is blind. He writes the messages in ink and employs a boy to read to him those that are to be sent. When by mistake the blind operator writes the message on the back of the blank, among the printed matter, and the boy is therefore unable to read it, the operator who sent the message has to repeat it, and often this is the first knowledge he has that he has been working with a blind telegrapher.

THE TELEPHONE.

The Erie Telegraph and Telephone Company has declared a dividend of 1 per cent., payable Nov. 16.

The Chesapeake and Potomac Telephone Company, of Washington, D. C., recently paid a dividend of 75 cents per share to its stockholders of record.

Richmond, Va.—A meeting will be held to consider the petition of the Bell Telephone Company for permission to construct underground conduits.

The Bell and Ottawa Companies to be United.—It is stated that a deal is at present in progress between the Bell Telephone Company and the Wallace Telephone Company, of Ottawa, which when completed will result in the purchase by the Bell company of the plant, stock, rights and interests of the latter company.

The National Telephone Manufacturing Company, of Boston, has recently installed several telephone lines for the Old Colony Railway Company which are giving, it is stated, the best of satisfaction. The company reports a large number of orders for other lines in Boston, and from the West and South, and the outlook is encouraging for an increased business.

The Southern New England Telephone Company is rapidly getting all its wires in Bridgeport underground. During last week, from Monday until Saturday night, 14 men pulled in 21,500 feet of 52 pair lead pipe cables, the weight of which was seven pounds to the foot. This is very fast work; in addition, the work was done very thoroughly. The new building of this company is practically finished, the underground wires have been connected into the building, and everything is now ready to set up the switchboards. The Southern New England Company has recently changed its switch-board in New Haven, and has now a new switch in which are 1,200 wires in metallic circuit multiple.

An operator in the Brooklyn, N. Y., central office is in the habit of addressing over the telephone a clerk in the office of a well known public man in that city in endearing terms. A few days ago the public man answered the phone. "Is that you, dear?" asked the lady with a musical voice. "No, darling," replied the distinguished public man, "it's the other fellow." It is the good fortune of some wives to make their appearance just in the nick of the most exasperating time. That is what happened in this instance. Behind the distinguished public man when he said, "No, darling, it's the other fellow," stood his wife, who had concluded to visit her husband that morning. She startled him by exclaiming, "Well, I like that!" Does any one suppose that she did?

European Telephone Statistics.—According to some official figures recently published as to the position of European countries, from the point of view of telephonic activity, Germany undoubtedly takes the lead, when we consider its vast population. In the German Empire there are about 105 subscribers per 100,000 inhabitants, as against 58 in Great Britain and 41 in France. In Berlin there are no less than 11.4 subscribers per 1,000 inhabitants, as against 4.2 for Paris and 1.5 for London. In the smaller countries of Europe, however, telephonic activity is considerably greater than in the larger ones; Sweden has 400 subscribers per 100,000 inhabitants, Switzerland 316 and Norway 255. The most talkative capital in Europe is apparently that of the diminutive Duchy of Luxembourg, where over 47 inhabitants per 1,000 are connected to the exchange. Russia makes a good last with 7 subscribers per 100,000 of its inhabitants.

THE ELECTRIC LIGHT.

Ipava, Ill.—The town is lighted with electric lights.

Leesburg, Va.—An electric light plant will soon be in operation.

Yreka, Cal.—The new electric light plant has been put in operation.

Brigham City, Utah.—The town is soon to be lighted by electricity.

Freeport, Ill.—An electric light plant will be erected by L. Z. Farwell.

Oakesdale, Wash.—There is talk of lighting the town by electricity.

Idaho Falls, Id.—The erecting of an electric light plant is contemplated.

Havana, Ill.—The City Council is considering the question of electric lighting.

Washington, O.—The Washington Shoe Company is installing an incandescent plant.

North Platte, Neb.—The City Council has been petitioned to light the streets by electricity.

Philadelphia, Pa.—The Powelton Electric Company is to double the capacity of its plant.

Gibson City, Ill.—A franchise has been granted to S. G. Le Fever to erect an electric light plant.

Montgomery, Ala.—The Montgomery Light Company is putting in a Thomson-Houston arc light plant.

Menominee, Wis.—J. D. Hills, of Eau Claire, contemplates establishing an electric light plant in the town.

Mt. Sterling, Ill.—The Mt. Sterling Electric Light Company contemplates adding a new dynamo to its plant.

Middletown, Ct.—The Middletown Electric Light Company has purchased two new Thomson-Houston dynamos.

Milwaukee, Wis.—Public sentiment is rapidly growing in favor of municipal control of the electric lighting system.

Napanee, Ind.—An electric light plant is to be erected by H. W. McIntyre, of Auburn, and Perry A. Early, of Napanee.

Findlay, O.—The Findlay Electric Light and Power Company is arranging to put in a meter system for its incandescent service.

Augusta, Me.—The new city electric light plant will be ready for operation as soon as the power house is completed at Fairfield.

Paterson, N. J.—The Edison Illuminating Company has put up 150 arc lights to replace the incandescent lights. The city now has 430 arc lights.

De Land, Fla.—Manager J. B. Clough, of the electric light plant, will change the arc system to an incandescent system within the next 30 days.

Albany, Mo.—The contract for the construction of an electric light plant has been let by the City Council to the Westinghouse Company for $7,250.

Factoryville, Pa.—It is stated that a company is being formed to erect an electric light plant to furnish light to Factoryville, Dalton and Nicholson.

Vergennes, Vt.—A contract has been signed with F. E. Briggs and E. S. Marsh, of Brandon, Vt., to install an electric light plant of 20 arc lights, of 2,000 c. p.

Roseburgh, Ore.—Charles Clevengar, electrician in charge of the new electric light plant which is being erected, expects to have the plant in operation soon.

Moorhead, Minn.—The City Council has contracted with the Fargo, N. Dak., Gas and Electric Company for five arc lights for five years at $100 per month.

Louisville, Ky.—The Louisville Gas Company has its new electric lighting plant in operation, and will furnish 175 lights for lighting the city at $66 each per annum.

Waterville, Mass.—The Thomson-Houston company has been awarded the contract to erect an electric light plant, with a capacity of 650 incandescent and 50 arc lights.

Creston, Ia.—The People's Electric Light and Power Company, recently organized, has been granted its franchise by the City Council, and will put in its plant at once.

Cherryfield, Me.—The Cherryfield Electric Light Company, it is stated, has decided to discontinue its present system and put in an alternating plant of a capacity of 650 lights.

Milwaukee, Wis.—A special committee of the Common Council is investigating electric lighting, and will report to the Council relative to the feasibility of the city's owning its own plant.

Vicksburg, Miss.—Sealed proposals for electric lighting will be received by the Mayor, R. V. Booth, until Dec. 7. Bids to be made on 30, 40 and 60 electric lights for three and five years.

Fort Wayne, Ind.—A meeting of the trustees of South Wayne was held recently and the electric lighting question was considered, with prospects that it will come to an issue soon.

Leavenworth, Kan.—The contract for furnishing the arc and incandescent apparatus for the plant of the new Merchants' Electric Light Company has been let to the Edison company.

Lander, Wyo.—The town is to have electric lights, having granted a franchise to a company for 10 years. The city contracts for 10 lights for 5 years at a rental of $5 per lamp per month.

Brooklyn, N. Y.—City Works Commissioner Adams has signed a contract with the Thomson-Houston company to erect a new electric light plant at the Ridgewood pumping station to cost $8,988.

Savannah, Mo.—The proposition to bond the city for $12,000 for electric lighting, recently voted upon, was carried by a vote of 220 to 32. It is not expected that the plant will be in operation before spring.

Jefferson, Wis.—A new lighting plant is being installed in the factory of the Copeland & Ryder company by Warner & Blinn, of Rockford, Ill. One hundred and twenty-five incandescents will be used for lighting.

Youngstown, O.—An ordinance was passed recently by the City Council, granting the Youngtown Electric Light Company the right for twenty years to erect poles and wires to put in arc lights for lighting the city.

San Bernardino, Cal.—The San Antonio Electric Light and Power Company is developing water power and will furnish incandescent lights and power to Pomona, Ontario, San Bernardino and other towns in the valley.

Bessemer, Ala.—The electric light plant of the Bessemer Light Company was blown to pieces recently and damaged to the extent of $5,000. The dynamos were uninjured and the plant will be in operation again in a few weeks.

Goshen, N. Y.—The Goshen Electric Light and Power Company has contracted with B. W. Payne & Son, of Elmira, N. Y., for two 60-h. p. engines and two 25-h. p. boilers for its central station, work on which is progressing rapidly.

Rahway, N. J.—It is reported that negotiations are pending for the purchase of the electric lighting plant of the Union Electric Light and Manufacturing Company, and that the arc system will be changed to incandescent.

Norwood, Mass.—It is stated that a town meeting is to be called to see if the town is favorable to authorizing the selectmen to grant permission to the Dedham Electric Light Company to wire and pole the town for electric lights.

Cicero, Ill.—The Town Board at its last meeting accepted the proposition of the Cicero Water, Gas and Electric Light Company to furnish 20-c. p. lights for $14 per year each, and 30-c. p. for $18 per year each. The contract holds for five years.

Oyster Bay, L. I.—A franchise has been granted by the Board of Highway Commissioners, to the National Electric Manufacturing and Construction Company, of New York, to control and operate an electric lighting plant in the village of Oyster Bay.

Thompsonville, Conn.—The town has voted to pay $1,500 per year for electric lighting, and the Enfield Electric Light and Power Company, of which Mr. L. A. Upson is president, has started to put in its plant, which it is expected will be in operation by the last of December.

Philadelphia, Pa.—Mr. T. W. South, president of the Suburban Electric Light and Power Company, is authority for the statement that the line of the Pennsylvania railroad from Frankford to Torresdale will be lighted with electric lights, the Suburban Company's plant furnishing the electricity.

Sealed Proposals will be received by J. H. Forbes, mayor of Greensboro, N. C., until Feb. 1, 1892, for lighting the city with electricity from April 15, 1892, bids to be made on not less than 50 arc lights of 1,500 c. p. or with incandescent lights of equal lighting capacity both by moon schedule and all night.

Bordentown, N. J.—The first electric plant to be installed in the town will be in the factory of Jacob Miller, Sons & Co., manufacturers of the Eagle shirt. A Cohen low speed dynamo will be used; capacity of the plant 200 incandescents. J. Ros. MacLaughlan, of Philadelphia, has the contract for supplying the plant.

Wilkinsburg, Pa.—The Wilkinsburg Electric Company has its plant in operation. The plant is equipped with a new 2,000-light dynamo, and a 1,300-light machine has been bought. The plant has three incandescent and two arc dynamos, and a capacity of 9,000 lights. It has at present in its circuit 6,500 incandescent and 47 arc lamps.

Greensburg, Pa.—The Board of Burgesses has awarded the contract for lighting the city by electricity to a company of which Mr. Morris L. Painter is president. The contract calls for 50 lights and is for a period of 10 years, the city to pay $80 per arc light. The new company will be known as the Westmoreland Light Company, capital stock $30,000.

Charlestown, W. Va.—The contract for installing the plant of the City Electric Light Company has been let to the Warfield Manufacturing Company, of Baltimore. The plant is to be in operation by Christmas. Charles C. Caldwell has been elected superintendent of the company and has charge of all the electrical and mechanical details of the plant.

Even in Syria, writes Mr. Sala, the last ten years have wrought conspicuous changes. On our first morning in Jaffa we were awakened by the screech of a railway whistle; there is an electric light just outside the Damascus Gate at Jerusalem; the shadow of a telegraph post falls upon Jacob's Well, near Sychar, and a steam mill puffs day and night hard by the ancient well of Nazareth.

Willimantic, Conn.—The new electric light company has organized, and a formal transfer of plants has been made to it by the old Willimantic Electric Light Company. The officers of the new company are: President, Gen. E. S. Boss; treasurer, O. H. K. Risley; secretary, Julius Pinney; other directors, Edwin Evans, Luther Hills, Spencer, Mass. The company expects to be in full operation in its new building by Dec. 1.

Lambertville, N. J.—The City Council recently passed an ordinance granting to the New York Electric Construction Company the exclusive right, for three years, to erect poles and run wires for electric light, heat and power. A local company has been organized to be known as the Lambertville Electric Light Company, which has contracted with the New York Electric Construction Company to put in a plant for the lighting of the city.

The Ohio University, at Athens, O., is enlarging its incandescent plant by adding to its present equipment a new motor-type direct current dynamo made by the Thomson-Houston company. The power will be furnished by a 10-h. p. Racine automatic engine. The work of installation is being done by the students in the engineering section. Both the buildings and the grounds will be lighted. In addition the students are assisting in running the city arc lighting plant.

THE ELECTRIC RAILWAY.

Monroe, Ala.—An electrical street railroad will be built by W. A. Bright.

Norfolk, Neb.—The Norfolk Electric Railway Company has its lines in operation.

Rome, Ga.—The Rome Street Railway Company has been bought out by New York and Washington capitalists.

Wilmington, N. C.—The Wilmington Street Railway Company is authorized to change its motive power to electricity.

Birmingham, Ala.—An electrical system will be adopted on the South Highland Street Railway lines by the Elyton Land Company.

Yonkers, N. Y.—The Yonkers Street Railway Company is petitioning for the right to change its motive power from horses to electricity.

Natural Bridge, Va.—An electric railroad will, it is stated, be built from the railroad station to the hotels, by the Glasgow Investment Company.

Chester, Ill.—By vote of the City Council over the veto of the Mayor, John D. Gerlach has been granted a franchise to erect an electric light plant.

Asheville, N. C.—The Asheville & Baltimore Company will build an electrical road from Asheville to Baltimore. W. E. Breese is president of the company.

Macon, Ga.—This city has had one street railway line in operation for some time. The work of constructing the two is rapidly progressing and is near completion.

Birmingham, Ala.—The electric street railway system is now in successful operation. The change of system from horse power to electric will cost the Birmingham Railway and Electric Company over $300,000.

Portland, Me.—S. D. Warren & Co., proprietors of the paper manufactory at Cumberland Mills, contemplate building an electric road from their plant, for hauling freight and for the use of the operatives of the mills.

The Jarvis-Conklin Mortgage and Trust Company, of Kansas City, Mo., has secured a controlling interest in the North Avenue Electric Railroad Company, of Baltimore; $1,000,000 is to be used in extending and completing the lines.

Savannah, Ga.—It is reported that the City and Suburban Railway, Coast Line Railroad, and the Thunderbolt and Sandfly Railway will pass into the control of the Brush Electric Light and Power Company, and that the lines will be changed to an electric system.

San Francisco, Cal.—Behrend Joost and J. W. Hartzell, of the San Francisco and San Mateo Electric Railway Company, have petitioned for a 50-year franchise to construct an electric railway on certain streets of the city, agreeing to expend $25,000 within a year and to pay two per cent of the annual gross earnings into the city treasury.

Rome, Ga.—It is stated that M. B. Marvin and Albert S. Bigelow, of New York, and J. F. Lawrence, O. G. Staples, and S. H. Buck, of Washington, D. C., who recently purchased the lines of the Rome Street Railroad Company, expect to erect an electric power plant, and contemplate doing electric lighting. Mr. Lawrence is president of the company.

Denver, Col.—The committee appointed to further the project for an extension of the Denver Tramway Company's electric line into Harmon are working to raise the necessary funds by Nov. 26. The tramway company offers to build an electric car line into Harmon within 60 days from contract, provided a subsidy of $8,500 is raised to help in the construction of the same.

Hampton, Va.—It was recently reported that the Hampton and Old Point Electric Railway Company had secured the right of way to Newport News for its railway. This report is denied. Fair progress is being made by the company, but they have, it is said, no assurance that the right of way into Newport News will be given. It is expected, therefore, that the company will be compelled to resort to condemnation proceedings.

The Chicago & Evanston Elevated Electric Railway Company, of Chicago, Ill., recently incorporated, contemplates the construction of an elevated road 12 miles long. It is not regarded as practicable, it is stated, as the profits must be small. At the same time it is admitted that it is the most ambitious attempt in the line of contemplated electric railway construction, except the road now planned between Boston and Lynn.

Oakland, Cal.—At a meeting of the directors of the Oakland Street Railway Company recently, the Oakland & Berkeley Rapid Transit Company, recently transferred to the Consolidated company, was formally incorporated with the other lines projected but not yet built. H. L. Coleman was elected superintendent of the consolidated lines, and J. Beggs was elected secretary, vice H. L. Hunt. The building of other lines was also discussed.

The Atlanta Traction Company, of Atlanta, Ga., has been formed by the consolidation of the Atlanta, West End and McPherson Barracks and the Grant Park Railway companies. George E. Hoppie will be president; Henry Lanier, treasurer; Henry Woodward, secretary. One hundred and fifty thousand dollars of bonds of the consolidated company have been sold to Baltimore capitalists. An expert appraised the property of the two companies at $240,000.

Electric Street Railways in Honolulu.—In a recent issue of the *Daily Bulletin*, published at Honolulu, Hawaii, it was stated that certain papers read at the recent electric light convention in Montreal conveyed information very interesting to the Honolulu public, in view of the fact that an act was passed by the legislature of 1890, authorizing the Hawaiian Tramway Company, without limit of time or any hard conditions, to use and maintain electric power for operating its cars, and that by the adoption of electric motors the service could undoubtedly be vastly increased in efficiency and profitableness, and lines be made feasible across the city on the steep grades that are impracticable of surmounting by horse car lines.

GENERAL APPLICATIONS OF POWER.

Dawson, Ky.—Electricity as a motive power has been put in use at the Hecla mines.

Burke, Idaho.—An electric plant is being placed in position at the Poorman mines. One of the dynamos is 225 h.p. The plant will be operated by water power.

Moline, Ill.—The People's Light and Fuel Manufacturing Company has contracted with the Thomson-Houston Electric Company for a 150-h. p. generator for electric motor service.

How Business Is Lost.—"We understand," says the *Electrical Engineer*, of London, "that in many mining districts in New Zealand small dynamos are being introduced for lighting purposes. In some parts the dynamos are driven by an engine burning coal or wood, but in many places an engine is not permissible. The motor most appreciated seems to be the Pelton water wheel. This water wheel is of American manufacture, the head offices being at San Francisco. A No. 2 motor has a wheel 12 inches in diameter, and can be coupled directly to the dynamo shaft. The head of water required must suffice to give a pressure of 140 pounds per square inch to furnish a speed of 1,350 revolutions per minute, and from this arrangement about 65 incandescent lamps of 16 c. p. can be run. The Americans have flooded the colonies with advertisements of their wares, and similar productions of English manufactures are almost unknown. In scores of cases where water is available Pelton wheels are being used or suggested, not only for electrical, but for other purposes where power is required. Most Englishmen seem to imagine that their wares are known everywhere, but this is a mistake, and the American houses are not slow to take advantage of it. Quite recently we have seen colonial indents for electric light plants which in every case specified Pelton water wheels—in fact, talking with a gentleman only just returned from one of the mining districts, it seems that no other similar apparatus is known in some places."

PERSONALS.

Mr. A. B. Coryell, of Flint, Mich., has been appointed electrician of the Fenton (Mich.) Electric Light and Power Company.

Mr. Charles G. Burton, formerly manager of the Lincoln, Neb., District Telegraph Company, has recently accepted of a position with The Electrical Construction Company, of Chicago.

Mr. E. E. Hartman, formerly in the employ of the Edison General Electric Company, with headquarters in Colorado, has recently accepted of a position with the Thomson-Houston Electric Company, and has located in Chicago.

Mr. D. T. Burritt, lately manager of the Southern New England Telephone Company, has recently accepted the position of manager of the Elizabeth, N. J., Electric Light Company. Mr. Burritt is succeeded in New Haven by Mr. W. G. Riggs.

Mr. James Mitchell, who recently left this country to represent the Thomson-Houston International Electric Company in Rio Janeiro, Brazil, and Mr. Lewis Degen, have arrived at their destination, and report the convalescence of Mr. Arthur H. Brown and Mr. J. G. Coolidge, well known in New York, from what was thought to be hopeless attacks of yellow fever. Their address is Caixa de Cornés, No. 954 Rio de Janeiro.

LEGAL NOTES.

A Receiver has been appointed for the Traylor Electric Company of Richmond, Va. P. H. C. Cabell is the receiver.

Boston, Mass.—In the suit of Edward B. Welch against Thomas A. Edison to recover $250,000 for an alleged breach of contract, the defendant made a motion recently in the United States Circuit Court, before Justice Nelson, to appoint an auditor to hear the plaintiff's claim. The judge denied the motion at the hearing, Oct. 31, on the ground that he did was think an investigation into the details of the enumerated patents necessary to determine the damages. The case will be heard this month.

A Permanent Injunction was granted recently in the United States Circuit Court by Judge Coxe, against the Julien Electric Company, from infringing the patents of the Electric Accumulator Company in the use of storage batteries on street cars and in other places. The defendants recently asked for a re-opening of the case on the ground that a Spanish patent of the Accumulator Company by expiring had invalidated its patents in this country. The Accumulator Company claims it was a different patent. Judge Coxe has decided that the injunction must stand. A commissioner was appointed Nov. 7 by Judge Lacombe to take testimony in connection with the suit in Madrid, Spain. The judge appointed H. R. Newberg, Chargé d'Affaires of the United States Legation at Madrid, Spain. Several witnesses are to be examined in regard to the claim made by the Julien company that the storage battery was only patented in Spain by the Accumulator Company, and the patent expired there, making the American patent void.

Effect on Contract of Sale of Threatened Suit for Infringement.—In an action for money due on written contract for the sale and erection of an electric light plant, it is no defense that the buyer had been notified that certain essential features of the plant were infringements of patents granted to a third party, and claims made for damages and suits threatened for such infringement, since these facts do not constitute a breach of the plaintiff's implied warranty of title. Evidence of a verbal promise to give a bond indemnifying the purchaser against claims for infringement being inadmissible, failure to give such bond is no defense where it is not alleged that the written agreement was procured on the faith of such verbal promise, nor that the promise was omitted from the written contract by fraud, accident, or mistake. The above decision was rendered in the case of the American Electric Construction Co. vs. Consumers' Gas Co., in the Circuit Court of the United States, Western District of Pennsylvania.

MISCELLANEOUS NOTES.

A Combined Engine and Generator is being manufactured by the Westinghouse Machine Company and the Westinghouse Electric and Manufacturing Company, of Pittsburgh, for the Minneapolis Street Railway Company.

The Newark Passenger Railroad Company, of Newark, N. J., had ten electric cars, valued at $6,000 each, and five track sweepers destroyed by fire on the morning of Nov. 4. The total loss on machinery, building, etc., was $125,000, fully insured.

A New Engineering Monthly, *Cassier's Magazine*, published by the Cassier Magazine Company, of New York, is a recent publication, the first number of which was issued Nov. 1. It is profusely illustrated, and its leading articles are contributions from some of the brightest minds of the country. It is perfect typographically, liberally patronized from an advertising standpoint, and is a bright, well edited publication, reflecting great credit on its publishers, Messrs. Louis Cassier and A. R. Thompson.

Industrial and Trade Notes.

A Very Neat specimen of advertising souvenirs has been received by THE ELECTRICAL WORLD from the Aluminum Brass and Bronze Company, of Bridgeport, Conn.; a lizard, cast in aluminium, which can be very handily used as a paper weight.

Mead & Stringham is a new firm which has been formed with offices in the Hammond Building, Detroit, Mich., where they will conduct general engineering and contracting business, acting as special agents for the Ball & Wood company. Both members of the firm are mechanical engineers with wide experience in steam construction, and well known to the trade throughout Michigan.

The Automatic Oil Filter for sale by the B. & S. Electric Equipment Company, of 115 Broadway, New York, is a new application in the process of filtering and purifying of lubricating oils by capillary attraction. These filters are claimed to have a number of points of advantage in simplicity, cheapness and in being perfectly automatic, and the expressions of those who have used them are general in regard to their efficiency.

The Jewell Belting Company, of Hartford, Conn, has issued two very neat and interesting publications in regard to the transmission of power by leather belting and the "Jewell" dynamo belt, how made, what it has done and what it will do. Both publications will prove of interest to all practical engineers and mechanics. We are indebted to the company for copies of each, which are appropriately lettered in gold, bearing the inscription on the covers of THE ELECTRICAL WORLD.

A Few Important Points for consideration by those contemplating the question of incandescent electric light plants are given in an illustrated catalogue recently issued by the Heisler Electric Light Company, of Philadelphia. The advantages of long distance series incandescent lighting are fully set forth and a description of the "Heisler" system is given in detail, conveying to the reader much valuable and interesting information in regard to the installation of incandescent plants.

The Camp Fire Lamp, which many of those who attended the convention of the National Electric Light Association at Montreal will remember as being among the exhibits, was designed and constructed by Mr. H. A. Cole, of Montreal, at the works of the Royal Electric Company, which owns and controls the same, patents having been applied for it in Canada and the United States. An illustration of this lamp was given in THE ELECTRICAL WORLD, Sept. 26, and in the report of the convention was referred to as exhibited by the Germania Electric Company, of Boston.

The following letter was recently received by the Electric Merchandise Company, of Chicago, in regard to the Burton electric heaters: "The Burton electric heaters you sent to the Escanaba Electric Street Railway Company have been put to a good thorough test and have been found equal to the emergency. We have had some cold weather and quite a fall of snow but the cars have been as warm as toast. Your heaters are the simplest, cleanest and most efficient of any heating apparatus in the market. You may use this in any manner you wish or refer to us at any time."

Testimonials is the caption of a recent pamphlet issued by the railway department of the Westinghouse Electric and Manufacturing Company, of Pittsburgh. It consists of 37 pages of complimentary letters received from companies that are using the Westinghouse street railway apparatus, in regard to the service of motors and generators manufactured by this company. All of the letters speak in the highest terms of the efficiency of the Westinghouse electrical equipment, and being opinions resulting from practical experience can be regarded as unbiased and worthy of consideration.

A Series of Tests have recently been made by Prof. Henry Morton, of the Stevens Institute of Technology, with the "Champion" battery, which has been placed on the market by the E. S. Greeley & Co., of New York. As a result of these tests, Prof. Morton reports that he found the battery to be an excellent one, equal to the test, and possessed of many distinctive advantages in comparison with others, viz., on open circuit or with a high resistance it shows an electromotive force in the proportion of 15 to 14 as compared with others. The battery also shows a remarkable promptness in recovering its electromotive force on the opening of the circuit. Thus it will recover 50 per cent. of its loss in one minute, while many batteries will only recover 10 per cent. in the same time.

The Interior Conduit and Insulation Company, of 42 Broad street, New York, has acquired the sole right from the Universal Arc Lamp Company to manufacture and sell the following apparatus: Universal constant potential, Universal short decorative and Universal railway circuit lamps for incandescent circuits, and Universal series high potential lamp and Universal theatrical and focusing lamp. A large portion of the extensive factory of the company will be devoted to the manufacture of these lamps. The Conduit company has taken the current customers of the Universal Arc Lamp Company and other accounts and will also pay any of its outstanding bills. Prompt shipments will be made on all present and future orders. The Interior Conduit and Insulation Company will be accorded a most liberal patronage in its new departure.

Silicon Bronze Trolley Wire, for electric railways, is regarded as having many essential qualities in electric railway construction, such as strength, ductility, wearing qualities and conductivity. This wire of the usual size for railway work, No. 4 B. W. G. (.238 inch diameter), weighs 905 pounds per mile, and has a tensile strength of over 80,000 pounds per square inch and a ductility of over 30 twists in 6 inches, shown by recent tests which have been made. The Aluminium Brass and Bronze Company, of Bridgeport, is the sole manufacturer of silicon bronze trolley wire. The company states that it is receiving the most flattering reports in regard to the use of this wire from many of the largest street railway companies of the country. The advantage of using silicon bronze wire was specially referred to by Mr. G. W. Mansfield in his paper read before the Street Railway Convention at Pittsburgh.

Mr. A. M. Morse, until recently of the firm of English, Morse & Co., of Kansas City, Mo., has removed to St. Louis and opened offices in the Commercial Building, corner Sixth and Olive streets. During the eight years that Mr. Morse has been located in Kansas City he has gained an extensive and favorable acquaintance among the steam users of the Southwest and has designed and furnished a large number of representative steam power plants in that section for electric lighting, electric railways, flour mills and manufacturing purposes. The business in the future will be conducted under the style of A. M. Morse & Co. They will represent leading manufacturers of high grade steam engines of the Corliss and high speed type, also improved boilers, steam pumps and other specialties, which go to make up complete steam power plants. They will handle the best class of machinery and will make a specialty of designing and furnishing complete steam power outfits for any service, also the improvement and extension of plants already established.

A Recent Issue of the Daily Beacon, Astabula, Ohio, contained the following: "The special session of the council called last evening to settle the electric light contract was one of the shortest on record, as it was only 22 minutes from the time Mayor Moore called order until an adjournment was made. All members were present, and as the consideration of the contract between the city and the Westinghouse Electric and Manufacturing Company was the only business that could be legally transacted at the meeting, it was at once taken up. The contract provides for the furnishing and erecting of the wires, poles, 51 arc lamps, two 60-light arc dynamos, and one 500-light incandescent dynamo. Nine bids were submitted by as many companies for the contract, but only five were considered: Thomson-Houston Western, Fort Wayne, Edison, and Westinghouse. After a careful investigation and examination of all these systems, the committee reported in favor of the Westinghouse company's bid, as they think their system better and more economical than any of the others. The system is the alternating one and the lamp instead of throwing a light down at an angle of about 45 degrees, as does the direct current, gives a light that penetrates farther into the darkness horizontally than the others. Councilman Raser offered a resolution that the mayor and clerk be authorized to sign the contract in behalf of the city. After a little discussion, this resolution was unanimously carried."

Modern High-Grade Wires.—The growing demand for wire to be used in damp places has led to the making of specially well insulated wires for work in mines, tunnels and the like. At the same time the quality of some of the rubber wires on the market has been steadily improved, so that the wires now largely used for indoor circuits will stand quite severe tests. An instance of this recently occurred in Utah, where the United Electric Company, of Salt Lake City, was called upon to explode about 100 pounds of dynamite in the Anchor mine at Park City. The object of this blast was to break through the bottom of a 900-foot shaft into the Anchor drain tunnel whereby the mine could be drained. The water in this shaft was up to the 300-foot level, or 600 feet deep—200 pounds pressure. The dynamite was encased in a sheet iron tube together with the electric exploders, and was lowered by means of a No. 14 Simplex braided rubber wire through the 600 feet of water to the bottom of the shaft. The first trial was not successful and the torpedo was pulled up, and it was found that the water had got into the torpedo through a poorly soldered joint in the sheet iron and had wet the exploder wires. To test the leading-in wires 2,000 feet of wire was placed in a barrel of water and allowed to remain over night. The next morning six caps were successfully exploded through the 2,000 feet of wire in the barrel of water. The repaired torpedo was then lowered to the bottom of the shaft and exploded, using Simplex. braided rubber wire that had been under water from 20 to 24 hours continuously. While this work was a complete success electrically, yet it failed to break the shaft through into the tunnel, as some error had been made in surveying the tunnel. It is to be noted that the wire used did not have the extra heavy insulation which is intended for mine work, but was the same grade of braided rubber wire which is being put into some of the largest buildings in the West. The sample used was taken at random from a lot of wire furnished by George Cutter.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

The Present Address of W. F. Murphy or Jack D. Clark, trading as Murphy & Clark, Electrical Engineers, Chattanooga, Tenn., is wanted. Any information of their whereabouts would be appreciated.

Vestibuled Combination Cars.—The latest addition to the matchless equipment of the Chicago & Alton Railroad comes in the form of combination smoking and day cars. These cars are divided into two parts, one half being given up to smokers, while the other half is devoted to regular passengers. They are vestibuled, heated by Baker's patent safety car heater, and contain all modern appliances, which in every way contribute to the comfort of the passenger. In the new cars a marked improvement over the old fashioned straight-backed car seat has been made, the backs in the new cars being very much like those found in the chairs of the Alton's famous reclining chair car. Combination cars, palace reclining chair cars (free of extra charge), Pullman sleeping cars and dining cars will now compose the equipment of the Alton's famous Chicago-Kansas City-Denver vestibuled limited trains, while the night trains between St. Louis and Kansas City will be made up of combination cars, palace reclining chair cars (free of extra charge), Pullman palace sleeping cars, and day cars, the entire train being vestibuled. In matter of equipment the Chicago & Alton Railroad leads all leaders.

The Chicago, Milwaukee & St. Paul Railway Company's 6,150 miles of road traverses a vast territory, rich in all the resources that insure industrial success. The industrial department is conversant with the iron, coal, lumber and tanbark; the water power (both river and artesian) for factory and electric power purposes, the markets, the transportation and financial facilities, and other interests on the line pertaining to industrial development, and disseminates information concerning same. A number of new factories have been induced to locate—largely through the instrumentality of this company—at enterprising towns on its lines. As the interest of the company is to secure the location of industries at places where the surroundings will insure their permanent success, the information furnished a particular industry is pertinent and reliable. In the Eastern States and in other parts of the world factories are so congested and distant from the actual market as to result in fierce and destructive competition. That the West is taking a place as one of the great manufacturing territories of the world is forcibly impressing itself upon discerning and enterprising manufacturers. Steps should be taken by such while the field is as yet not fully covered, and while inducements are still being offered to locate in the West. Individuals or companies wishing to embark capital in Western industry can find a profitable field. For particulars relative to industrial advantages on the line, address Luis Jackson, Industrial Commissioner C., M. & St. P. Ry., 160 Adams street, Chicago, Ill.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED NOV. 3, 1891.

462,231. Electric Railway; Edward M. Bentley, of New York. Application filed Nov. 23, 1888. The combination of a slotted conduit and a supply conductor therein, with transverse guide supported from the vehicle on yielding supports, and a current collector moving transversly in said guide and in contact with said conductor.

462,237. Electric Lighting System; Joseph I. Conklin, of Brooklyn, N. Y. Application filed Feb. 9, 1891. An electric lighting system consisting of the combination of the main or charging circuit incorporating a dynamo, storage battery and circuit closer, the cut-out circuit incorporating two magnets and armatures therefor, and a local battery, with the armatures arranged to engage each other and one constructed to operate the circuit closer of the main circuit, an automatic switch in the cut-out circuit, controlled by main circuit, for alternately energizing said magnets of the cut-out circuit, and a lamp circuit connected to the storage battery.

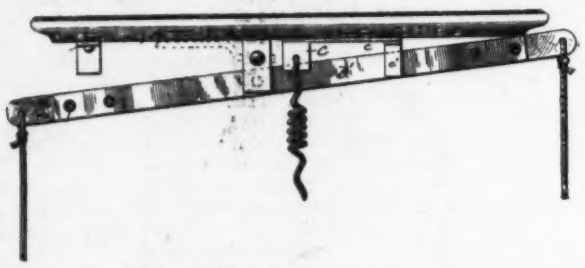
462,261. Automatic Electric Welding Machine; Hermann Lemp and Carl G. Anderson, of Lynn, Mass., said Lemp Assignor to the Thomson Welding Company, of Maine. Application filed Feb. 2, 1891. The combination, with the sliding carriage or work holder in an electric welding or metal working apparatus, of a series of gauges or stop pins of adjusted lengths for keeping the same retracted at different determinate positions, dependent upon the size of the work.

462,262. Laminated Die, Hammer, etc., for Electric Metal-Working Apparatus; Hermann Lemp, Lynn, Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed Feb. 24, 1891. In an electric metal-working apparatus, metal dyes, hammers, or other devices or parts which require to be in contact with the heated work for a greater or less time while the current is passing through it, having their working surfaces where they engage in the work laminated or sub-divided in planes transverse to the direction of the flow of current.

462,263. Method and Apparatus for Constructing Electric Light or Other Lines; Hermann Lemp, of Lynn, Mass., Assignor to the Thomson Electric Welding Company, of Maine. Application filed March 30, 1891. The invention consists in forming the joints by means of a portable electric metal-working machine carried to the joint and supplied with electric energy taken from conductors in the vicinity of the work being done, the machine being temporarily connected to said conductors for that purpose.

462,311. System of Electric Lighting; Frank M. Garland, of New Haven, Conn., Assignor of two-thirds to Nicholas W. Hubinger and Joseph E. Hubinger, both of same place. Application filed Sept. 9, 1890. A system for lighting vehicles, which consists of an air pump operated by the rotation of an axle of the vehicle, a motor operated by the air forced through the pump, a surrounding casing for said air pump, a dynamic electrical generator connected with the motor, an exhaust pipe establishing communication between said motor and surrounding casing, secondary batteries, lamps, the connection between the lamps, generator and battery, and a ventilator projected within said vehicle and communicating with the casing surrounding the air pump, whereby a continual circulation of air in the vehicle is maintained.

462,321. Electromagnetic Separator; Richard R. Moffatt, of New York, and Sylvester Chichester, of Brooklyn, N. Y. Application filed Jan. 20, 1891. The process of separating magnetic from non-magnetic particles, which consists in agitating the mixed particles in a magnetic field of force by the attractive forces of gravitation and pulsatory magnetism.



No. 462,353.—Electric Switch.

462,322. Electromagnetic Separator; Richard R. Moffatt, of New York, and Sylvester Chichester, of Brooklyn, N. Y. Application filed Feb. 2, 1891. In an electromagnetic separator, means for producing an intermittent or pulsating magnetic field, combined with a face plate arranged to be vibrated by the intermittent magnetic force.

462,338. Incandescent Lamp; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Dec. 27, 1886. An incandescent electric lamp having its entering wire or conductors twisted around one another where they pass through and are embedded in the material of the lamp-globe, so as to be normally held apart by such material.

462,339. Incandescent Lamp; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed March 12, 1887. The combination, with an incandescent lamp, of a shunting switch having a bias toward its circuit-closing contact and normally held out of action by a part within the vacuous space of the lamp located to be acted upon by the heat of the electric arc forming on rupture of the incandescing conductor.

462,345. Electric Signaling System; Frank B. Wood, of New York, Assignor to the Brewer & Smith Visual Signal Company, of New Haven, Conn. Application filed Jan. 6, 1890. In a signaling system, a single metallic circuit, a series of sub-stations located in the said circuit, and each containing a signaling mechanism, and a switch having an individual segment located in a different position in each sub-station, and a collective segment connected with the said individual segment and having the same position in all the sub-stations, and a central station having segments corresponding to the individual and collective segments of the sub-stations.

462,349. Ceiling Block; Axel Ekstrom, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. A ceiling or connection block having a central body with a surrounding undulating flange, and having clamping jaws for the main, and lamp wires on opposite sides of said flange and in the hollows thereof.

462,353. Electric Switch; Maurice Hoopes, of West Chester, Pa. Application filed Aug. 4, 1891. In an electric switch, a pair of parallel levers separated from each other along their middle portions, with their ends bent inward toward each other, and secured to the opposite sides of blocks of insulating material, in combination with two contacts arranged to make connection, respectively, with the levers on one side of the axis, and a single contact arranged to make connection with the levers on the opposite side of the axis. (See illustration.)

462,359. Clamp for Trolley Wires; Chas. A. Lieb, of New York. Application filed July 28, 1891. A clamp for trolley wires having two jaws or parts movable relative to each other and permanently attached together, and a spindle threaded into one of the parts, which engages the other part, whereby their clamping surfaces may be adjusted toward or from each other. (See illustration.)

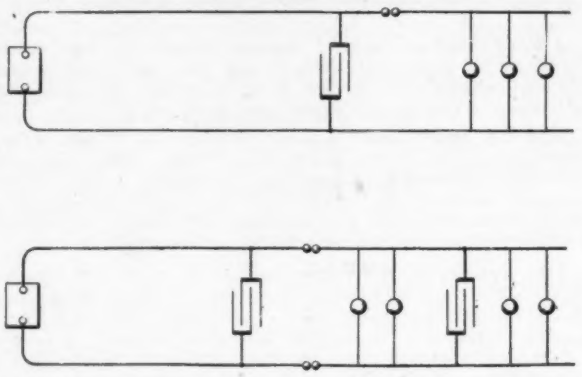
462,369. Controlling Device for Electric Motors; Francis O. Blackwell, of New York, Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed July 13, 1889. The combination, with an electric motor, of a current controller and circuit reverser therefor, a common actuator positively operating both, but allowing the controller a pre-determined amount of lost movement relative to the reverser.

462,381. Electric Alarm Bell; Chas. A. Hale, of Cleveland, O., Assignor to the Time Electric Company, of same place. Application filed June 5, 1891. A base frame formed with means for attaching the circuit wires, and contact post magnet core, and pole pieces, all formed integral from one piece of metal.

462,407. Electric Switch; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company of Connecticut. Application filed May 22, 1891. In an electric switch, having metallic contacts for closing the circuit between the terminals, carbons or fusible contacts, also for closing the circuit between the terminals, a movable hand operated part for successively opening the metallic contacts and fusible contacts, and feeding mechanism for automatically feeding the fusible contacts by the normal operation of the switch to compensate for consumption.

462,418. Method of and Apparatus for Electrical Conversion and Distribution; Nikola Tesla, New York, N. Y. Application filed Feb. 4, 1891. The method of electrical conversion, which consists in charging a condenser or conductor possessing capacity and maintaining a succession of intermittent or oscillating disruptive discharges of said conductor into a working circuit containing translating devices. (See illustration.)

462,444. Electric Lighting Apparatus; Harrison B. Meech, of Chicago, Ill. Application filed Nov. 24, 1890. An electric lighting apparatus comprising an inclosing globe containing a series of electric lamps, a supporting neck for said globe and lamp formed with a circular track with the stationary supporting housing having a circular track, the series of electric lamps and the inclosing globe rotating together.



No. 462,418.—Method of and Apparatus for Electrical Conversion and Distribution.

462,449. Secondary Battery; John H. Palmer, of Boston, Mass. Application filed Jan. 3, 1891. In a storage or secondary battery, a plate formed of laminated pillars connected to each other by metallic bars, the said pillars composed of thin pieces of lead or other material separated and kept apart by interposing parts or projections.

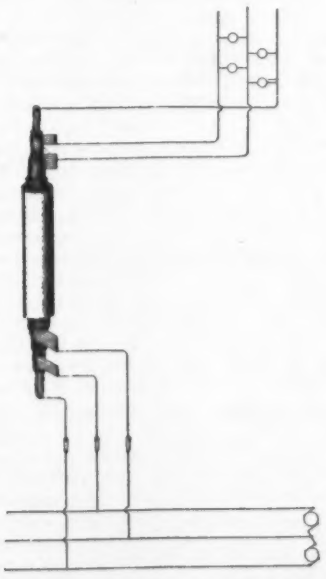
462,452. Electric Fuse Cut-Out; Edwin Wilbur Rice, Jr., of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed Oct. 18, 1890. A fuse for the protection of electric circuits comprising a plurality of fuse wires bundled together, each insulated by a separate insulating sheath and all attached to a single set of terminals, furnishing means for including the fuse in an electric circuit.

462,463. Switch and Cut-Out Device; Henry Price Ball, of Brooklyn, Assignor to the Edison General Electric Company, of New York. Application filed March 23, 1891. The combination of an insulating base, several metal terminals thereon, means for connecting either of said terminals to an external circuit, another terminal separated from the first mentioned terminal by an insulating screen, a fusible conductor connecting each of the terminals on one side of the screen to the terminal on the opposite side, and a screen over said fusible conductors and movable in such manner as to uncover some of said fusible conductors without uncovering the rest.

462,466. Commutator Brush; Francis O. Blackwell, of New York, Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed March 5, 1889. The combination, with a brush holder, of a containing box, a number of independent wires placed therein, and a layer of felt or similar substance giving an independent resiliency to each wire.

462,489. Conductor for Three-Wire Systems; Edward H. Johnson, of New York. Application filed Sept. 2, 1891. In a three-wire system, a cable having three conductors, one surrounding the other two, and the outer conductor being connected to the neutral wire of the system. (See illustration.)

462,504. Electric Current Meter; Johan W. Th. Olan, of New York, Assignor of one-half to Edward H. Johnson, of the same place. Application filed April 16, 1891. The combination in an electrical meter, of a needle or pointer, a coil or magnet for moving it, through which the current to be measured passes, a plate over which the needle moves in a regular arc, a record sheet between the plate and the needle, mechanism for advancing the sheet, and means operating through the needle while it is out of contact with the sheet for marking on the sheet the position of the needle.



No. 462,489.—Conductor for Three-Wire Systems.

462,513. Automatic Signal Apparatus; Joseph B. Stewart, of Haverstraw, Assignor of one half to William G. Wattson, of Tappan, N. Y. Application filed Dec. 23, 1890. In a block signal system, a series of electrically operated signals, a series of normally closed local circuits, each including a signal, a series of normally open line circuits, a series of track instruments, each adapted to open a local and close a line circuit upon the passage of a train, and a series of relays in the line circuits for closing the local circuits, the line circuits being normally open at the track instruments.

462,527. Electric Elevator; Harry H. Blades and William J. McKee, of Detroit, Mich. Application filed Jan. 11, 1890. The combination with an elevator, of an electric motor located thereon, rack-bars at the sides of the well, gearing engaging the said rack-bars with the armature shaft and switch located on the elevator for governing the admission of current to the motor, and a running rope extending from the top to the bottom of the well, connected with said switch, whereby a person on any floor may operate the said switch, and cause the elevator to ascend or descend.

462,532. Electric Cooking Stove; John V. Capek, of New York. Application filed Dec. 15, 1890. An electric stove having a heating chamber, a heater supported at one side thereof, and an adjustable partition for varying the size of the heating chamber.

462,540. Incandescent Electric Lamp; Thomas Alva Edison, of Llewelyn Park, N. J. Application filed March 25, 1889. The improvement in the method of making incandescent electric lamps, which consists in heating the filament of a lamp to a temperature much below its normal incandescence after the lamp is exhausted and sealed.

462,571. Electric-Lamp Cover and Switch; Emil T. Mueller, of La Crosse, Wis. Application filed April 30, 1891. The invention consists of a lamp and lamp socket and a pair of curves, one of which has an arm prolonged within the socket and provided with a contact spring for making electrical connections.

462,574. Key-Socket for Double-Filament Incandescent Lamps; William James McCutcheon, Jr., of Pittsburgh, Pa. Application filed June 18, 1891. A socket consisting of a frame, two parallel non-conducting plates therein, two connecting means on the upper plate, two conducting-brackets respectively and separately electrically connected with said connecting means, an insulated socket, permanently electrically connected with one of the said brackets, two separate contact plates in the under side of the lower conducting plate having their respective contacts on the upper side thereof, a key-shaft mounted in said brackets and insulated from one bracket and provided with the two contacts in electrical connection with the other bracket.

462,578. Trolley for Electric Cars; Robert D. Nuttall, of Allegheny, Pa. Application filed June 19, 1891. In a trolley for electric cars, the combination of a pivoted yoke provided with a socket for the trolley-rod, a swivel head upon which said yoke is pivoted, with a horizontal rod extending out from each side of the said swivel head, spiral springs surrounding said horizontal rod, cross heads sliding on the same, and flexible connections attaching said cross heads to the yokes.

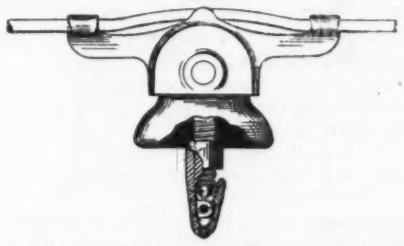
462,595. Electric Railway; James B. Sheldon and Daniel J. Murnane, of St. Louis, Mo., Assignors to the Underground Electric Traction Company, of Missouri. Application filed Feb. 12, 1891. In an electric railway, a series of yieldingly secured rotating stationary switches located in the conduit and having connection with a source of electricity and devices on the motor car adapted to conduct the current from said switches to the motor.

462,599. Electric Hair Brush; Alexander Stanton, of Lynn, Mass. Application filed Aug. 3, 1891. In combination, the brush stock, the casing having compartments formed by the horizontal partition, the battery in one compartment and the tufts having the connections extending through the other compartment, said casing being connected to the stock.

462,624. Electric Arc Lamp; Thomas Conroy, of Kansas City, Mo., Assignor of two-thirds to Albert W. Dold and Lewis P. Fuhrman, of same place. Application filed Feb. 16, 1891. An electric lamp comprising a spool having a vertical opening, a rod working in said opening, a lever to which said rod is attached, a frame to which said lever is fulcrumed, a carbon supporting rod, and brushes connected with the frame and having their ends crossed on the rod and in contact therewith.

462,648. Threading Rod for Underground Conduits; Frank G. Bolles, of Washington, D. C. Application filed Sept. 3, 1891. The combination, in a conduit needle or threading rod, of a joint or coupling consisting of two ferrules having projections, the projection of one portion having one or more holes, and the opposite projection having one or more hooks.

462,660. Electric Arc Lamp; Fred H. Carpenter, of Boston, Mass., Assignor to the Russell Electric Company, of same place. Application filed May 1, 1891. In an electric arc lamp, a disc carbon and its holder journaled in a supporting frame, which is attached to a carbon rod, and a spring provided with a lip secured at one end to the said frame, its free end pressed upon one end of the said carbon holder.



No. 462,359.—Clamp for Trolley Wires.

462,661. Electric Arc Lamp; Fred H. Carpenter, of Boston, Mass., Assignor to the Russell Electric Company, of same place. Application filed May 7, 1891. A detachable extension device for electric lamps, provided with means for locking with the lamp and means for supporting the globe.

462,662. Carbon Holder for Electric Arc Lamps; Henry E. Chapman, of Melrose Highlands, Assignor to the Russel Electric Company, of Boston, Mass. Application filed May 1, 1891. A means for holding the disc carbon of an electric lamp consisting of a spindle having journals at both ends, having a pinion at one end, and provided with a screw-threaded portion at about its centre, a collar permanently secured to the spindle beyond the screw-threaded portion with its inner face at right angles to the spindle, arms projecting from the inner face of the collar toward the threaded portion of the spindle, passing through the centre of the disc carbon, and having their ends turned inward so as to encircle the spindle, and a nut mounted on the screw-threaded portion of the spindle and having its inner end beveled and adapted to enter between the ends of the said arms.

462,663. Pencil-Carbon Holder for Electric Lamps; Henry E. Chapman, of Melrose Highlands, Assignor to the Russell Electric Company, of Boston, Mass. Application filed May 7, 1891. A pencil-carbon holder for electric arc lamps, consisting of a standard secured to the lamp frame and provided with a pair of lugs, screws mounted in the said lugs, clamps carried by the inner ends of the said screws and each having its inner face provided with beveled recesses at right angles to each other, one of the screws having an annular groove near its inner end, and a pin in the clamp carried by the said screw engaging said groove.

462,669. Stay for Suspended Electric Lights; Fred A. Johnson, of Bath, Me., Assignor of one-half to Francis W. Weeks, of same place. Application filed July 21, 1888. The combination, with a frame of a suspended electric lamp, of a stay composed of a coiled spring having its outer end looped and hooked for ready and quick attachment to suitable supports, and a detachable insulator connected to the inner end of the spring and open or divided, so that it can be attached to the side bars of said frame at any point without removing the end bars thereof.

462,672. Conduit Electric Railway; Archibald J. Robertson, of New York. Application filed Dec. 10, 1890. In electric railways and cars, the combination, with the track rails, an open receiver extending longitudinally thereof and provided with insulation for a main conductor, and the naked slack main conductor arranged in said receiver and extending lengthwise thereof, of a car truck mounted on said track-rails, an insulated carrier-pulley mounted on said truck and arranged above the level of said receiver, the elevated bight of the conductor taking over and resting on said pulley, an electric motor on said truck and the trolley of said motor, said trolley resting on the elevated portion of said conductor, whereby when the car truck moves along the track the carrier-pulley under-runs the conductor and keeps it in contact with the trolley, the main conductor rising out of and falling back into said receiver as the car moves along.

462,673. Electric-Arc Lamp; Edwin C. Russell, of Boston, Mass., Assignor to the Russell Electric Co. of same place. Application filed May 21, 1891. An electric arc lamp in which the regulation of the positive carbon is accomplished by means of main and secondary or shunt magnets in pairs, and a lever of the first order, with an armature on each end pivoted between each of the said pairs of magnets, the lower edge of one or both of the said armatures being inclined relative to the respective magnet cores.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.